BENTON HARBOR POWER PLANT LIMNOLOGICAL STUDIES

PART XXXI. PHYTOPLANKTON OF THE SEASONAL SURVEYS OF 1980, 1981, AND APRIL 1982, AND FURTHER PRE- vs. POST-OPERATIONAL COMPARISONS AT COOK NUCLEAR PLANT

John C. Ayers

Laurie E. Feldt

Under Contract with:

American Electric Power Service Corporation

Indiana & Michigan Electric Company

Special Report No. 44
of the
Great Lakes Research Division
The University of Michigan

December 1983

PREVIOUS PARTS OF THE REPORT SERIES RELATIVE TO THE

DONALD C. COOK NUCLEAR PLANT

Benton Harbor Power Plant Limnological Studies

Part

I. General studies. J. C. Ayers and J. C. K. Huang. April 1967. 31 pp.

II. Studies of local winds and alongshore currents. J. C. Ayers, A. E. Strong, C. F. Powers, and R. Rossmann. December 1967. 45 pp.

III. Some effects of power plant waste heat on the ecology of Lake Michigan. J. R. Krezoski. June 1969. 78 pp.

IV. Cook Plant preoperational studies 1969. J. C. Ayers, R. F. Anderson, N. W. O'Hara, C. Kidd. March 1970. 92 pp.

V. Winter operations, March 1970. N. W. O'Hara, R. F. Anderson, W. L. Yocum, J. C. Ayers. April 1970. 17 pp.

VI. Pontoporeia affinis (Crustacea, Amphipoda) as a monitor of radionuclides released to Lake Michigan. C. C. Kidd. 1970. 71 pp.

VII. Cook Plant preoperational studies 1970. J. C. Ayers, D. E. Arnold, R. F. Anderson, H. K. Soo. March 1971. 72 and 13 pp.

VIII. Winter operations 1970-1971. J. C. Ayers, N. W. O'Hara, W. L. Yocum. June 1971. 41 pp.

IX. The biological survey of 10 July 1970. J. C. Ayers, W. L. Yocum, H. K. Soo, T. W. Bottrell, S. C. Mozley, L. C. Garcia. 1971. 72 pp.

X. Cook Plant preoperational studies 1971. J. C. Ayers, H. K. Soo, W. L. Yocum. August 1972. 140 and 12 pp.

XI. Winter operations 1971-1972. J. C. Ayers, W. L. Yocum. September 1972. 26 pp.

XII. Studies of the fish population near the Donald C. Cook Nuclear Power Plant, 1972. D. J. Jude, T. W. Bottrell, J. A. Dorr III, T. J. Miller. March 1973. 115 pp.

XIII. Cook Plant preoperational studies 1972. J. C. Ayers and E. Seibel (eds.). March 1973. 281 pp.

XIV. Winter operations 1972-1973. J. C. Ayers, W. L. Yocum, E. Seibel. May 1973. 22 pp.

PREVIOUS REPORTS continued

XV. The biological survey of 12 November 1970. J. C. Ayers, S. C. Mozley, J. C. Roth. July 1973. 69 pp.

XVI. Psammolittoral investigation 1972. E. Seibel, J. C. Roth, J. A. Stewart, S. L. Williams. July 1973. 63 pp.

XVII. Program of aquatic studies related to the Donald C. Cook Nuclear Plant. J. C. Ayers and E. Seibel (eds.). December 1973. 57 pp.

XVIII. Effect of a thermal discharge on benthos populations: Statistical methods for assessing the impact of the Cook Nuclear Plant. E. M. Johnston. December 1973. 20 pp.

XIX. The seasonal biological surveys of 1971. J. C. Ayers, S. C. Mozley, J. A. Stewart. December 1974. 181 pp.

XX. Statistical power of a proposed method for detecting the effect of waste heat on benthos populations. E. M. Johnston. December 1974. 29 pp.

XXI. Bacteria and phytoplankton of the seasonal surveys of 1972 and 1973. J. C. Ayers. November 1975. 153 pp.

XXII. Underwater operations in southeastern Lake Michigan near the Donald C. Cook Nuclear Plant during 1974. J. A. Dorr III and T. J. Miller. December 1975. 32 pp.

XXIII. Phytoplankton of the seasonal surveys of 1974 and 1975 and initial pre- vs. post-operational comparisons at Cook Nuclear Plant. J. C. Ayers, N. V. Southwick, and D. G. Robinson. June 1977. 279 pp.

XXIV. Entrainment of phytoplankton at the Donald C. Cook Nuclear Plant - 1975. R. Rossmann, N. M. Miller, and D. G. Robinson. November 1977. 265 pp.

XXV. Phytoplankton of the seasonal surveys of 1976, of September 1970, and pre- vs. post-operational comparisons at Cook Nuclear Plant. J. C. Ayers. April 1978. 258 pp.

XXVI. Entrainment of phytoplankton at the Donald C. Cook Nuclear Plant - 1976. R. Rossmann, L. D. Damaske, and N. M. Miller. 1979. 88 pp., plus Appendix of 3 microfiche cards (154 pp.).

XXVII. Phytoplankton of the seasonal surveys of 1977, and further pre- vs. post-operational comparisons at Cook Nuclear Plant. J. C. Ayers and S. J. Wiley. March 1979. 92 pp.

XXVIII. Entrainment of phytoplankton at the Donald C. Cook Nuclear Plant - 1978. W. Chang, R. Rossmann, J. Pappas, and W. L. Yocum. May 1981. 106 pp., plus Appendix of 3 microfiche cards.

PREVIOUS REPORTS continued

Seibel, E. And J. C. Ayers (eds.). 1974. The biological, chemical, and physical character of Lake Michigan in the vicinity of the Donald C. Cook Nuclear Plant. Special Report No. 51 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 475 pp.

Jude, D. J., F. J. Tesar, J. A. Dorr III, T. J. Miller, P. J. Rago, and D. J. Stewart. 1975. Inshore Lake Michigan fish populations near the Donald C. Cook Nuclear Power Plant, 1973. Special Report No. 52 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 267 pp.

Seibel, E., C. T. Carlson and J. W. Maresca, Jr. 1975. Lake and shore ice conditions on southeastern Lake Michigan in the vicinity of the Donald C. Cook Nuclear Plant: winter 1973-74. Special Report No. 55 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 62 pp.

Mozley, S. C. 1975. Preoperational investigations of zoobenthos in southeastern Lake Michigan near the Cook Nuclear Plant. Special Report No. 56 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 132 pp.

Rossmann, R. 1975. Chemistry of nearshore surficial sediments from southeastern Lake Michigan. Special Report No. 57 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 62 pp.

Evans, M. S. 1975. The 1975 preoperational zooplankton investigations relative to the Donald C. Cook Nuclear Power Plant. Special Report No. 58 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 187 pp.

Ayers, J. C. 1975. The phytoplankton of the Cook Plant monthly minimal surveys during the preoperational years 1972, 1973, and 1974. Special Report No. 59 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 52 pp.

Evans, M. S., T. E. Wurster, and B. E. Hawkins. 1978. The 1975 and 1976 operational zooplankton investigations relative to the Donald C. Cook Nuclear Power Plant with preoperational tests (1971-1976) for plant effects. Special Report No. 64 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 192 pp.

Jude, D. J., F. J. Tesar, J. C. Tomlinson, T. J. Miller, N. J. Thurber, G. G. Godun, and J. A. Dorr III. 1979. Inshore Lake Michigan fish populations near the D. C. Cook Nuclear Power Plant during preoperational years - 1973, 1974. Special Report No. 71 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 529 pp.

Rossmann, R., W. Chang, L. D. Damaske, and W. L. Yocum. 1980. Entrainment of phytoplankton at the Donald C. Cook Nuclear Plant - 1977. Special Report No. 67 of the Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 180 pp.

TABLE OF CONTENTS

	Page
PREVIOUS PARTS OF THE REPORT SERIES RELATIVE TO THE DONALD C. COOK NUCLEAR PLANT	iii
FIGURES	viii
TABLES	ix
ACKNOWLEDGMENTS	x
INTRODUCTION	1
TECHNIQUES	5
RESULTS AND DISCUSSIONS	7
Phytoplankton Summary Tables	7
Dominant and Codominant Phytoplankters	8
Master Lists of Phytoplankters Collected	29
Establishment of *Cyclotella comensis*	30
Inner-Outer Graphical Comparisons: Diversity Indices	30
Inner-Outer Graphical Comparisons: Phytoplankton Redundancies	40
Inner-Outer Graphical Comparisons: Phytoplankton Abundances by Algal Categories	45
Inner-Outer Statistical Comparisons: Phytoplankton Abundances by Algal Categories	80
CONCLUSIONS	88
REFERENCES	90

Appendices are in microform inside back cover

APPENDIX A: PHYSICAL MEASUREMENTS

APPENDIX B: PHYTOPLANKTON COLLECTIONS

APPENDIX C: MASTER LISTS OF PHYTOPLANKTON COLLECTED

LIST OF FIGURES

Figure		Page
1.	The Cook Plant 36-station sampling grid used for phytoplankton after April 1972	3
2.	Mean diversity indices of phytoplankton collections in three depth zones and inner-outer station groups. Preoperational 1970-1974 and operational 1975-1982.	
	2A Depth zone 0 (0-8 m)	34
	2B Depth zone 1 (8-16 m)	36
	2C Depth zone 2 (16-24 m)	38
3.	Mean redundancies of phytoplankton collections from three depth zones and inner-outer station groups. Preoperational 1970-1974 and operational 1975 through 1982	42
4.	Mean abundances of ten categories of phytoplankton in three depth zones and inner-outer station groups. Preoperational 1970-1974 and operational 1975 through April 1982.	
	4A Filamentous green algae	52
	4B Desmids	54
	4C Filamentous blue-green algae	56
	4D Coccoid green algae	58
	4E "Other algae"	60
	4F Coccoid blue-green algae	62
	4G Flagellates	64
	4H Pennate diatoms	66
	4I Centric diatoms, zone 0	68
	4J Centric diatoms, zone 1	70
	4K Centric diatoms, zone 2	72
	4L Total algae, zone 0	74
	4M Total algae, zone 1	76
	4N Total algae, zone 2	78

LIST OF TABLES

Table		Page
1.	Comparison of the original 54-station seasonal sampling grid to the 36-station sampling grid used after April 1972.	4
2.	Phytoplankton summary tables, 1980, 1981, and April 1982	9
3.	Dominant and codominant phytoplankters in the Cook Plant seasonal surveys of preoperational 1970-1974 and operational 1975 through April 1982	21
4.	Means, standard errors, and numbers of observations of phytoplankton diversities by seasons, depth zones, and inner and outer station groups in operational 1980	31
5.	Means, standard errors, and numbers of observations of phytoplankton redundancies by seasons, depth zones, and inner and outer station groups in operational 1980, 1981, and April 1982	44
6.	Means, standard errors, and numbers of observations of abundances of ten categories of phytoplankton by seasons, depth zones, and inner and outer station groups during 1980, 1981, and April 1982	47
7.	Statistical tests of mean abundances of ten categories of phytoplankton at inner and outer station groups by seasons and depth zones in 1980, 1981, and April 1982	83

ACKNOWLEDGMENTS

Our thanks are tendered to a number of persons who have assisted in the carrying out of this study.

To members of the phytoplankton staff who conducted the tedious but essential work of counting and identifying phytoplankton samples, we extend our sincere gratitude; they were: James Barres, Julie Wolin, Robert Genter, and David Farris in 1980; Robert Genter, Julie Wolin, and Margie Ladzick in 1981; and Julie Wolin and Margie Ladzick in 1982. One of us (LEF) also served in this capacity in each of the years.

For field assistance rendered by members of the fisheries, benthos, and zooplankton sections, we are grateful.

As always the captain and crew of the R/V MYSIS have provided much appreciated field assistance over and above their mere duty.

Dr. William Chang is gratefully acknowledged for assistance in statistical matters.

INTRODUCTION

The Donald C. Cook Nuclear Plant is located on the southeastern shore of Lake Michigan, in Lake Township, Berrien County, Michigan. The plant is approximately 11 miles south of Benton Harbor and 2 miles north and west of Bridgman, Michigan.

A two-unit electric generating station, the plant is rated at 2,200 megawatts and draws cooling and service water from Lake Michigan through three intake pipes from approximately 2,250 feet offshore in 24 feet of water. The plant employs a once-through cooling system, returning used cooling water to the lake through two diffuser discharge structures located approximately 1,200 feet offshore in 18 feet of water.

Unit 1 began operating in January 1975 and unit 2 in early 1978. With both units at full power the condenser cooling water flow rate is 1,645,000 gpm (3,650 cfs) and the total heat rejection rate is 15.5×10^9 Btu per hour. Unit 1 at full power imparts to the condenser cooling water a temperature rise of 21.8 F°; unit 2 at full power produces a rise of 16.7 F° in its cooling water. Used cooling water from unit 1 returns to the lake through a two-slot diffuser discharge structure; that from unit 2 through a three-slot diffuser discharge structure. The exit velocities at both diffusers are about 13 ft/sec. The discharge velocities create an area of high turbulence in front of each discharge structure. The regions of high turbulence are short-lived, both temporally and spatially, as ambient water is rapidly entrained into the discharged water and the velocity of the discharged water falls quickly to ambient current velocity.

Phytoplankters drawn into the plant with cooling water are subject to

sudden increase in temperature, mauling by pumps, high velocity discharge, and rapid dilution with cooler water.

Operation of the plant, then, has at least the potential of affecting the structure of the phytoplankton community.

The strategy for detecting changes in the phytoplankton community near the Cook Plant involves comparisons of phytoplankton abundances in three depth zones near the plant to abundances in the same three depth zones at distances 2 miles or more away from the plant. In any one survey these comparisons are spatial but, repeated over time, they allow temporal comparisons as well. The temporal comparisons primarily consist of conditions in preoperational years compared against operational years. Conditions in preoperational years provide a measure of natural variation against which variations in operational years may be compared to detect possible plant-related perturbations.

This report serves the double purpose of recording the results of seasonal surveys made in 1980, 1981, and April 1982 and of reporting additional preoperational vs. postoperational analyses according to the strategy outlined above.

Figure 1 shows the station positions of the present 36-station sampling grid centered on the Cook Plant. This grid, used after April 1972, replaced an earlier 54-station grid. Table 1 compares the two sampling grids and shows the stations dropped and stations retained in changing to the 36-station grid.

At all complete stations in Figure 1 phytoplankton, zooplankton, benthos, and physical measurements are collected during the seasonal surveys. The physical measurements consist of surface-water temperature, water depth, Secchi disc water transparency, and water color as seen above the white 20-cm Secchi disc, as well as weather conditions and wind and wave characteristics. The seasonal physical data are given in Appendix A.

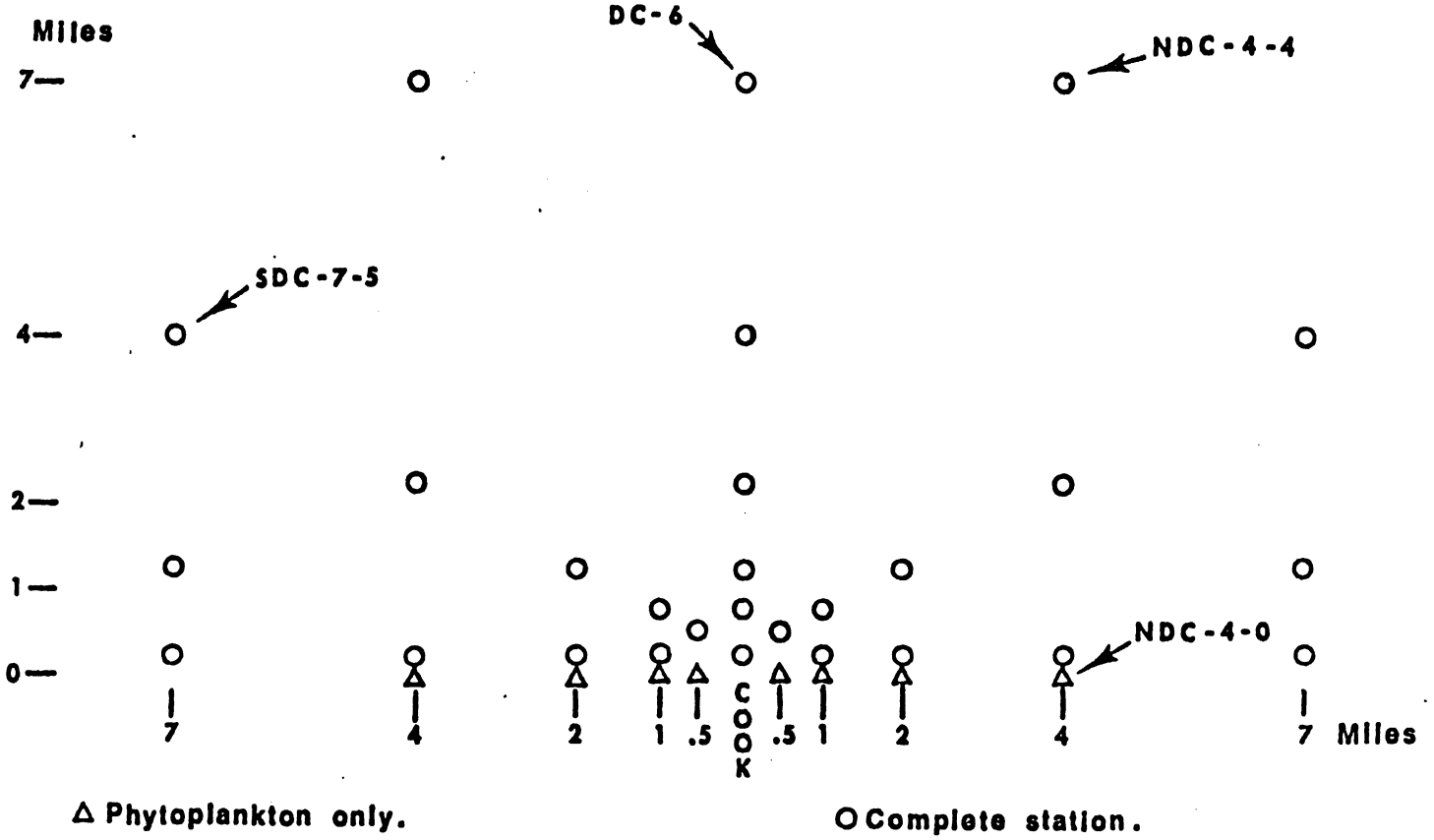


FIG. 1. The present 36-station Cook Plant sampling grid, used since April of 1972. The stations are designated as follows: SDC stations are located south of the plant, NDC stations are north of the plant, and DC stations are directly offshore of the plant. The first number in the designation is the number of miles north or south of the plant. The second number is the serial number of the station from shore lakeward. The serial number of the phytoplankton-only stations is 0.

TABLE 1. Comparison of the original 54-station seasonal sampling grid to the 36-station sampling grid which was instituted in the April 1972 seasonal survey at Cook Plant. X denotes a retained station. -- denotes an omitted station.

Station	54-station grid	36-station grid	Station	54-station grid	36-station grid
DC-1	X	X	NDC-7-3	X	X
DC-2	X	X	NDC-7-4	X	--
DC-3	X	X	NDC-7-5	X	X
DC-4	X	X	SDC-.25-1	X	--
DC-5	X	X	SDC-.5-0	X	X
DC-6	X	X	SDC-.5-1	X	--*
NDC-.25-1	X	--	SDC-.5-2	X	X
NDC-.5-0	X	X	SDC-.5-3	X	--
NDC-.5-1	X	--*	SDC-1-0	X	X
NDC-.5-2	X	X	SDC-1-1	X	X
NDC-.5-3	X	--	SDC-1-2	X	X
NDC-1-0	X	X	SDC-1-3	X	--
NDC-1-1	X	X	SDC-2-0	X	X
NDC-1-2	X	X	SDC-2-1	X	X
NDC-1-3	X	--	SDC-2-2	X	--
NDC-2-0	X	X	SDC-2-3	X	X
NDC-2-1	X	X	SDC-2-4	X	--
NDC-2-2	X	--	SDC-4-0	X	X
NDC-2-3	X	X	SDC-4-1	X	X
NDC-2-4	X	--	SDC-4-2	X	--
NDC-4-0	X	X	SDC-4-3	X	X
NDC-4-1	X	X	SDC-4-4	X	X
NDC-4-2	X	--	SDC-7-1	X	X
NDC-4-3	X	X	SDC-7-2	X	--
NDC-4-4	X	X	SDC-7-3	X	X
NDC-7-1	X	X	SDC-7-4	X	--
NDC-7-2	X	--	SDC-7-5	X	X

*Sampled occasionally in the years since 1972.

Occasionally weather or logistical difficulties result in some stations of a survey being taken a day ahead of or a day later than the bulk of the stations. This results in different dates on the phytoplankton station collection sheets which are reproduced in Appendix B. It has been our custom to use the day when the bulk of the stations were taken as the date of the survey.

Parts of the material presented here have been used by the Indiana & Michigan Electric Company in their Cook Plant Annual Environmental Operating Reports. Other parts, including the appendices of physical data, phytoplankton station collections, and master lists of phytoplankton collected, were not in the company report and have been added. The master lists of phytoplankton collected constitute Appendix C.

TECHNIQUES

Phytoplankton samples are collected by Niskin bottle from a depth of 1 m, with the exception of the nearshore stations. Nearshore collections (serial number zero stations) are made by submerging an open 1-liter bottle 4 inches below the water surface. All samples are 1-liter whole samples. Each sample is fixed with Utermohl's iodine fixative immediately after collection and stored in an opaque container.

In the laboratory, each sample is concentrated to 100 mL by settling in a 1,000-mL graduate cylinder and siphoning off 900 mL of fluid. The concentrated sample is stored in a 100-mL opaque bottle.

The samples of 1971 and of April 1972 were prepared and counted by the Utermohl technique: placing an aliquot of the concentrated sample in a tubular combination settling and counting chamber and allowing the aliquot to settle overnight. The counting chamber containing the settled cells was then separated

from the settling chamber, covered, and placed on the microscope. The samples were counted on a binocular inverted microscope at 1,000X magnification.

Beginning with July 1972, and continuing since, the method of concentration for species identification and enumeration has been the settle-freeze method as proposed by Sanford et al. (1969). The method entails 2 days' settling of 1,000 mL of sample in a graduated cylinder. On the third day the top 900 mL are siphoned off and discarded. Part of the remaining 100 mL is used for preparation for the microscope slide and the rest is kept for any possible further references or back checking.

The once-settled sample is then diluted if need be and settled again, this time in 18-mL cylinders. These cylinders are attached with a small amount of stopcock lubricant (to prevent leakage) to the microscope slides which rest on an aluminum plate one quarter inch thick. The whole apparatus is then secured together mechanically. The microscope slides, prior to having the cylinders placed on them, were treated with Dessicote to provide a hydrophobic surface to the slide. After the samples have settled overnight, the aluminum plate on which they rest is placed on a block of dry ice for 90 seconds or less. This freezes the bottom 1-1.5 mL. The unfrozen part is then discarded and the cylinders are removed from the slides. The slides are then placed in an anhydrous ethanol chamber for 2 days, and then in a toluene chamber for 2 days.

The first chamber removes the excess water and the second prepares the samples for their final mounting in toluene-based Permount®. One drop of Permount® is put on the slide, a cover slip is then placed over it, and the slide is allowed to dry for 2 days or more.

The specimens are counted, at 1,200X under oil immersion on a Leitz Ortholux microscope, to species, variety, and form when practical, otherwise to genus

or group. Only those specimens that appear to have been viable at the time of collection are counted. Two sweeps of the slide are made, one vertical and one horizontal. This provides an indication of the randomness of the species on the slide.

All species are counted to individual cells, except for filamentous blue-green algae with cylindrical trichomes which are counted as individual organisms. Prior to 1974 all colonial blue-greens were counted as single organisms; the change in counting resulted in an apparent increase of blue-greens beginning in 1974.

Phytoplankton abundances derived from the counts are calculated as cells per liter, but are divided by 1,000 in the computer print-outs.

Species and forms are presented in the way in which they are recognized and counted. Examples are: The flagellate Cryptomonas is recognized and counted separately from unidentified "Flagellates"; Anacystis and Chroococcus are no longer recognized as separate entities, but counted together as Anacystis in accordance with Drouet's (1968) revision of blue-green taxonomy.

RESULTS AND DISCUSSIONS

The authors believe that the materials presented in this section will be more convenient for both authors and readers if presentation of the results and discussion of the results are not separated. We believe that the reader will have no difficulty in distinguishing between the objective presentation of the results and our subjective discussion of them.

Phytoplankton Summary Tables

The phytoplankton summary tables employed here are based on the ones used by the Michigan Water Resources Commission at the time our reporting procedures

were established (MWRC 1970). Our summaries differ from theirs in that we count the numbers of cells in filamentous and colonial forms (except blue-green algae with cylindrical trichomes which are counted as individual organisms), while the Commission counts a filament or colony as a single organism. The station collection records from which the summaries were prepared constitute Appendix B.

The summary table for each seasonal survey presents, station-by-station, the surface-water temperature at the time of collection, the numbers per mL of each of ten major categories of planktonic algae, and the dominant (and codominant, see below) species or groups. The categories of phytoplankton employed are: coccoid blue-green algae, filamentous blue-green algae, coccoid green algae, filamentous green algae, flagellates, centric diatoms, pennate diatoms, desmids, other algae, and total algae. The summary tables allow quick assessment of the general compositions of the populations sampled, the ambient water temperature, and give the dominant and codominant species or groups (forms). The summary tables presented in Table 2 cover the surveys of spring (April), summer (July), and fall (October) of 1980, 1981, and April 1982.

Dominant and Codominant Phytoplankters

In each phytoplankton sample, one form (species or group) is typically present in greater abundance than the others. We designate these species or groups as "dominant." In many samples, however, one or more other species or groups will come close to matching the numbers of the dominant form; we designate these slightly less abundant forms "codominants" and list them along with the dominant in the "Dominant species" column of Table 2.

In Table 3 the dominant and codominant forms in the station collections of each seasonal survey of 1970 through April 1982 have been assembled and the

TABLE 2. Phytoplankton summary tables. Surface water temperature in °C and densities (cells/mL) of major phytoplankton groups. Densities have been computed as cells per liter and divided by 1000.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
10 APRIL 1980												
DC-0	10.2	0	6.6	71.3	0	369.7	369.7	373.1	0	160.8	1351.3	Chrysophycean flagellates
DC-1	10.1	0	0	58.0	0	514.0	379.7	487.5	0	0	1439.2	Flagellates Asterionella formosa
DC-2	3.8	0	3.3	33.2	0	925.2	776.0	583.6	3.3	9.9	2334.6	Rhodomonas minuta Chrysophycean flagellates
DC-3	3.7	132.6	61.3	41.5	18.2	659.9	437.7	285.2	0	203.9	1840.5	Chrysophycean flagellates
DC-4	2.8	199.0	1.7	33.2	0	643.3	439.4	349.9	0	24.9	1691.2	Flagellates
DC-5	1.8	0	3.3	31.5	0	643.3	386.3	92.9	0	11.6	1168.9	Chrysophycean flagellates
DC-6	1.8	0	4.1	3.3	0	465.1	107.8	18.2	0	7.5	606.0	Flagellates
NDC-.5-0	10.2	0	6.6	311.7	0	480.8	603.5	769.3	0	99.5	2271.5	Flagellates Fragilaria crotonensis Unknown green colony
NDC-.5-1	7.7	0	3.3	341.6	0	822.4	1323.1	2029.5	0	29.8	4549.7	Fragilaria crotonensis Asterionella formosa Chrysophycean flagellates
NDC-.5-2	8.0	248.7	1.7	9.9	0	288.5	570.4	645.0	0	3.3	1767.5	Asterionella formosa Gomphosphaeria lacustris Stephanodiscus minutus
NDC-1-0	10.5	0	13.3	46.4	0	427.8	1475.7	1843.8	0	13.3	3820.2	Fragilaria crotonensis
NDC-1-1	6.2	530.6	13.3	9.9	0	1867.0	1717.8	1359.6	0	86.2	5584.4	Asterionella formosa Chrysophycean flagellates Rhodomonas minuta
NDC-1-2	3.9	0	5.0	28.2	0	300.1	1039.6	416.2	0	3.3	1792.4	Stephanodiscus minutus
NDC-2-0	9.6	0	9.9	199.0	19.9	885.4	703.0	971.6	0	106.1	2895.0	Flagellates
NDC-2-1	5.7	0	3.3	102.8	0	560.4	1857.0	1601.7	0	3.3	4128.6	Asterionella formosa
NDC-2-3	3.7	0	3.3	0	0	877.1	840.6	868.8	1.7	33.2	2624.7	Rhodomonas minuta Asterionella formosa
NDC-4-0	8.8	26.5	0	19.9	0	812.5	610.2	533.9	0	19.9	2022.8	Rhodomonas minuta Flagellates Chrysophycean flagellates
NDC-4-1	5.8	0	0	33.2	0	640.0	1200.4	610.2	0	3.3	2487.1	Stephanodiscus minutus Asterionella formosa
NDC-4-3	2.8	0	0	6.6	0	384.7	553.8	147.6	0	6.6	1099.3	Stephanodiscus minutus
NDC-4-4	1.5	0	0	26.5	0	1102.6	242.1	51.4	1.7	44.8	1469.0	Rhodomonas minuta
NDC-7-1	5.4	0	26.5	26.5	0	2871.8	1425.9	1857.0	0	225.5	6433.3	Rhodomonas minuta Chrysophycean flagellates
NDC-7-3	3.7	9.9	0	0	0	981.6	636.7	434.4	3.3	79.6	2145.5	Flagellates
NDC-7-5	2.2	406.2	6.6	11.6	0	890.4	729.5	502.4	14.9	21.6	2583.3	Rhodomonas minuta Asterionella formosa Chrysophycean flagellates Stephanodiscus minutus

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
10 APRIL 1980 continued.												
SDC-.5-0	9.8	3.3	3.3	537.2	0	829.0	543.8	809.1	0	308.4	3034.3	Flagellates
SDC-.5-1	4.7	0	3.3	0	0	878.8	676.5	716.3	0	9.9	2284.8	Asterionella formosa Rhodomonas minuta Chrysophycean flagellates
SDC-.5-2	3.8	696.4	0	13.3	0	570.4	1250.2	358.1	0	0	2888.3	Anacystis incerta
SDC-1-0	8.8	0	16.6	749.4	6.6	1177.2	388.0	504.1	3.3	39.8	2885.0	Gloeocystis sp. Flagellates
SDC-1-1	4.8	0	3.3	13.3	0	699.7	1681.3	1346.3	6.6	56.4	3806.9	Asterionella formosa Stephanodiscus minutus
SDC-1-2	3.8	126.0	0	3.3	0	1067.8	1140.7	746.1	0	0	3084.0	Rhodomonas minuta Asterionella formosa
SDC-2-0	9.9	0	9.9	679.8	0	1469.0	527.3	716.3	0	132.6	3535.0	Chrysophycean flagellates
SDC-2-1	4.8	0	3.3	69.6	0	1223.7	1475.7	935.1	6.6	23.2	3737.3	Rhodomonas minuta Asterionella formosa
SDC-2-3	3.4	26.5	19.9	26.5	0	1233.6	421.1	441.0	0	39.8	2208.5	Rhodomonas minuta Chrysophycean flagellates
SDC-4-0	9.0	0	6.6	13.3	0	1459.1	921.9	1067.8	0	39.8	3508.5	Flagellates Chrysophycean flagellates
SDC-4-1	4.7	0	13.3	99.5	0	1482.3	1260.1	676.5	3.3	16.6	3551.6	Rhodomonas minuta Flagellates Chrysophycean flagellates
SDC-4-3	3.4	218.9	6.6	43.1	0	1213.7	630.1	487.5	0	9.9	2609.8	Rhodomonas minuta Chrysophycean flagellates
SDC-4-4	1.6	0	18.2	14.9	0	1755.9	245.4	82.9	0	61.3	2178.7	Rhodomonas minuta
SDC-7-1	4.8	0	39.8	79.6	0	1684.6	902.0	1021.4	0	245.4	3972.7	Rhodomonas minuta Chrysophycean flagellates
SDC-7-3	3.9	0	0	3.3	0	1177.2	1299.9	543.8	9.9	23.2	3057.5	Asterionella formosa Rhodomonas minuta Stephanodiscus minutus
SDC-7-5	2.9	58.0	1.7	29.8	0	1001.5	606.9	336.6	0	31.5	2065.9	Rhodomonas minuta
9 JULY 1980												
DC-0	21.2	596.9	238.8	46.4	0	351.5	736.2	3488.6	0	179.1	5637.4	Fragilaria crotonensis Asterionella formosa
DC-1	18.4	243.7	417.0	63.0	0	692.2	73.8	921.1	4.1	250.4	2665.3	Fragilaria crotonensis Anabaena flos-aquae Chrysophycean flagellates
DC-2	18.1	83.7	158.3	102.8	0	782.6	47.3	503.2	0.8	168.3	1847.1	Chrysophycean flagellates
DC-3	18.1	162.1	64.7	59.7	0	424.0	22.4	195.2	0.4	52.2	980.7	Chrysophycean flagellates
DC-4	18.0	333.3	109.4	154.6	0	494.5	61.8	251.2	0.4	57.2	1462.4	Anacystis incerta Chrysophycean flagellates

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
9 JULY 1980 continued.												
DC-5	19.4	144.3	239.2	84.1	0	471.3	50.6	161.7	0.4	40.2	1191.7	Anabaena flos-aquae
DC-6	19.0	55.5	269.4	92.0	0	384.3	33.2	119.0	0	40.6	994.0	Chrysophycean flagellates Anabaena flos-aquae
NDC-.5-0	21.3	212.2	0	172.4	0	278.6	676.5	6672.0	0	557.1	8568.9	Asterionella formosa
NDC-.5-1	18.1	0	14.9	119.4	0	703.0	71.3	898.7	0	96.2	1903.5	Fragilaria crotonensis Chrysophycean flagellates
NDC-.5-2	18.6	209.7	200.6	203.9	0	441.0	70.5	945.1	0	38.1	2109.1	Fragilaria crotonensis Asterionella formosa Fragilaria crotonensis
NDC-1-0	21.1	56.4	11.6	54.7	0	116.1	235.4	1969.8	0	69.6	2513.6	Asterionella formosa
NDC-1-1	18.2	391.3	84.6	74.6	0	596.9	82.9	777.6	0	174.1	2182.0	Fragilaria crotonensis Anacystis incerta Asterionella formosa Chrysophycean flagellates
NDC-1-2	18.4	132.6	93.7	87.9	0.8	447.7	57.2	271.1	0	61.3	1152.4	Fragilaria crotonensis Chrysophycean flagellates
NDC-2-0	20.6	132.6	935.1	106.1	0	510.7	444.4	3203.4	0	470.9	5803.2	Fragilaria crotonensis Anabaena flos-aquae Asterionella formosa
NDC-2-1	18.1	205.6	33.2	81.2	0	674.8	46.4	393.0	0	96.2	1530.4	Fragilaria crotonensis Chrysophycean flagellates
NDC-2-3	18.7	213.9	238.8	102.8	0	456.0	48.1	514.0	5.0	28.2	1606.7	Fragilaria crotonensis Anabaena flos-aquae Asterionella formosa
NDC-4-0	19.6	414.5	82.9	59.7	0	460.9	218.9	1750.9	0	76.3	3064.1	Chrysophycean flagellates Asterionella formosa
NDC-4-1	17.8	140.9	8.3	92.0	0	631.7	72.1	777.6	0.8	50.6	1774.1	Anacystis incerta Asterionella formosa
NDC-4-3	18.0	238.8	46.4	76.3	3.3	437.7	66.3	493.3	2.5	65.5	1430.1	Fragilaria crotonensis Fragilaria crotonensis
NDC-4-4	19.0	272.8	315.9	121.9	0	543.0	48.1	250.4	0	51.4	1603.3	Asterionella formosa Anabaena flos-aquae
NDC-7-1	19.3	165.8	330.0	154.2	1.7	631.7	81.2	613.5	1.7	74.6	2054.3	Anabaena flos-aquae Fragilaria crotonensis Asterionella formosa Chrysophycean flagellates
NDC-7-3	19.1	248.7	78.8	29.8	0	377.2	40.6	208.9	1.7	83.7	1069.5	Flagellates Chrysophycean flagellates
NDC-7-5	18.1	737.8	174.1	40.6	0	428.6	34.0	192.3	0.8	50.6	1658.9	Anacystis incerta Anacystis incerta
SDC-.5-0	20.7	1061.2	33.2	0	0	490.8	470.9	4012.5	0	331.6	6400.1	Asterionella formosa Anacystis incerta

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
9 JULY 1980 continued.												
SDC-.5-1	19.1	540.5	51.4	100.3	0	455.1	57.2	455.1	0	58.9	1718.6	Anacystis incerta
SDC-.5-2	18.9	247.9	24.9	69.6	0	517.3	41.5	475.9	0	69.6	1446.7	Fragilaria crotonensis Chrysophycean flagellates
SDC-1-0	20.3	563.7	79.6	79.6	0	271.9	358.1	2553.4	0	364.8	4271.2	Asterionella formosa
SDC-1-1	19.5	335.8	39.8	184.9	0	460.1	82.9	1046.2	0.8	82.9	2233.4	Fragilaria crotonensis
SDC-1-2	19.0	321.7	41.5	68.8	0	625.1	56.4	411.2	1.7	153.4	1679.6	Chrysophycean flagellates
SDC-2-0	21.4	0	122.7	3.3	0	315.0	248.7	1631.5	0	155.9	2477.1	Asterionella formosa
SDC-2-1	19.4	150.1	74.6	171.6	0	268.6	58.0	776.8	3.3	30.7	1533.7	Fragilaria crotonensis
SDC-2-3	19.2	9.9	5.0	193.2	0	283.5	90.4	654.1	1.7	29.0	1266.8	Fragilaria crotonensis
SDC-4-0	21.7	1193.8	165.8	378.0	0	1532.1	238.8	3190.1	6.6	298.5	7003.7	Anacystis incerta Asterionella formosa Flagellates
SDC-4-1	20.0	518.1	74.6	99.5	0	578.7	34.8	208.1	0.8	79.6	1594.2	Anacystis incerta
SDC-4-3	20.0	87.9	53.9	155.4	0	283.5	30.3	121.0	0.4	22.0	754.4	Flagellates
SDC-4-4	19.5	51.8	70.1	66.7	0	248.3	61.3	63.0	0	18.2	579.5	Flagellates
SDC-7-1	20.2	14.9	180.7	170.8	0	401.3	58.9	356.5	1.7	44.8	1229.5	Flagellates
SDC-7-3	19.9	189.4	89.1	186.9	0	276.1	46.4	238.8	0	49.7	1076.5	Flagellates Anacystis incerta Fragilaria crotonensis
SDC-7-5	19.5	230.1	166.2	144.7	0	276.1	41.9	301.8	0.8	41.0	1202.5	Fragilaria crotonensis Flagellates Anabaena flos-aquae Gomphosphaeria lacustris
15 OCTOBER 1980												
DC-0	14.4	3515.1	6.6	232.1	19.9	208.9	1853.7	1439.2	0	43.1	7318.7	Anacystis incerta
DC-1	13.3	2780.6	136.0	97.8	16.6	436.1	1656.4	1024.7	0	102.8	6250.9	Anacystis incerta Gomphosphaeria lacustris Cyclotella comensis
DC-2	15.2	9411.2	89.5	407.9	3.3	1634.9	795.9	918.6	0	315.0	13576.2	Anacystis incerta
DC-3	15.2	2311.3	152.5	179.1	0	653.3	1419.3	782.6	0	271.9	5770.1	Anacystis incerta
DC-4	13.2	3621.2	13.3	53.1	0	490.8	1087.7	504.1	0	86.2	5856.3	Anacystis incerta
DC-5	12.5	1580.1	46.4	53.1	0	407.9	853.9	213.9	0	19.9	3175.2	Anacystis incerta Cyclotella comensis
DC-6	11.9	2064.3	33.2	89.5	0	298.5	293.5	56.4	0	29.8	2865.1	Gomphosphaeria lacustris

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
15 OCTOBER 1980 continued.												
NDC-.5-0	15.0	2105.7	189.0	334.9	16.6	437.7	1551.9	580.3	3.3	142.6	5362.2	Gomphosphaeria lacustris
NDC-.5-1	12.8	650.0	3.3	162.5	9.9	1173.9	331.6	248.7	0	271.9	2851.9	Flagellates
NDC-.5-2	12.8	1727.7	0	192.3	23.2	689.8	1366.2	401.3	3.3	225.5	4629.3	Chrysophycean flagellates Anacystis incerta
NDC-1-0	14.6	1605.0	6.6	106.1	0	1260.1	610.2	537.2	0	351.5	4476.8	Anacystis incerta
NDC-1-1	12.4	3846.7	9.9	242.1	6.6	1804.0	978.3	739.5	0	308.4	7935.5	Gomphosphaeria lacustris
NDC-1-2	12.8	965.0	0	53.1	0	563.7	931.8	325.0	0	99.5	2938.1	Anacystis incerta
NDC-2-0	13.0	2560.1	13.3	696.4	33.2	1081.1	683.1	676.5	0	271.9	6015.4	Anacystis incerta
NDC-2-1	12.2	2374.3	126.0	139.3	9.9	1018.1	1256.8	258.7	6.6	112.7	5302.5	Gomphosphaeria lacustris
NDC-2-3	12.4	2361.1	23.2	298.5	155.9	769.3	1253.5	1124.2	0	189.0	6174.6	Gomphosphaeria lacustris
NDC-4-0	---	2327.9	13.3	689.8	19.9	669.9	1193.8	703.0	0	517.3	6134.8	Gomphosphaeria lacustris
NDC-4-1	11.8	2971.3	36.5	451.0	13.3	1074.4	1561.9	772.7	0	205.6	7086.6	Anacystis incerta
NDC-4-3	12.4	2155.5	23.2	238.8	6.6	596.9	799.2	703.0	3.3	129.3	4655.8	Anacystis incerta Gomphosphaeria lacustris
NDC-4-4	11.9	1704.5	39.8	44.8	0	293.5	225.5	154.2	3.3	26.5	2492.1	Anacystis incerta
NDC-7-1	12.5	921.9	39.8	388.0	92.9	1701.2	1021.4	819.1	0	590.3	5574.4	Anacystis incerta Rhodomonas minuta
NDC-7-3	12.9	384.7	8.3	232.1	9.9	749.4	250.4	240.4	0	222.2	2097.4	Flagellates Flagellates
NDC-7-5	13.0	1107.6	0	63.0	0	729.5	812.5	268.6	0	89.5	3070.7	Anacystis incerta Gomphosphaeria lacustris Cyclotella comensis
SDC-.5-0	13.4	4284.4	16.6	252.0	0	663.2	981.6	888.7	0	215.5	7302.1	Anacystis incerta
SDC-.5-1	14.3	2526.9	9.9	116.1	0	673.2	344.9	563.7	3.3	305.1	4543.1	Anacystis incerta
SDC-.5-2	15.7	1217.0	0	89.5	6.6	709.7	338.2	351.5	0	159.2	2871.8	Gomphosphaeria lacustris Anacystis incerta
SDC-1-0	15.0	1936.6	6.6	331.6	0	1406.0	1120.9	709.7	0	577.0	6088.4	Anacystis incerta
SDC-1-1	13.2	1187.2	3.3	169.1	3.3	663.2	467.6	315.0	0	215.5	3024.3	Anacystis incerta
SDC-1-2	13.9	2032.8	136.0	155.9	0	842.3	941.8	288.5	0	89.5	4486.7	Anacystis incerta
SDC-2-0	13.6	1154.0	13.3	444.4	13.3	815.8	941.8	643.3	0	669.9	4695.6	Gomphosphaeria lacustris Anacystis incerta
SDC-2-1	13.2	1411.0	3.3	150.9	0	346.5	885.4	565.4	0	69.6	3432.2	Anacystis incerta
SDC-2-3	13.2	1477.3	11.6	94.5	0	598.6	316.7	271.9	1.7	248.7	3021.0	Anacystis incerta Gomphosphaeria lacustris
SDC-4-0	14.0	4005.9	26.5	172.4	0	590.3	1445.8	1445.8	0	132.6	7819.4	Anacystis incerta Gomphosphaeria lacustris

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
15 OCTOBER 1980 continued.												
SDC-4-1	13.1	2689.4	139.3	63.0	0	716.3	404.6	291.8	0	142.6	4446.9	Anacystis incerta
SDC-4-3	13.5	7322.0	6.6	202.3	3.3	1266.8	434.4	480.8	0	139.3	9855.5	Anacystis incerta
SDC-4-4	12.2	2896.6	64.7	19.9	0	424.5	409.5	131.0	3.3	54.7	4004.2	Anacystis incerta
SDC-7-1	12.9	563.7	0	145.9	0	596.9	278.6	477.5	3.3	89.5	2155.5	Rhodomonas minuta Gomphosphaeria lacustris
SDC-7-3	12.9	626.7	288.5	165.8	0	921.9	401.3	172.4	0	132.6	2709.3	Flagellates Unknown blue-green colony
SDC-7-5	12.6	9802.5	96.2	39.8	0	629.1	235.4	242.1	0	102.8	11138.9	Anacystis incerta
10 APRIL 1981												
DC-0	10.6	0	6.6	0	6.6	968.3	742.8	1485.6	0	126.0	3336.0	Asterionella formosa Flagellates
DC-1	9.8	1061.2	33.2	112.7	0	1963.1	557.1	1054.5	0	172.4	4954.3	Anacystis incerta Flagellates
DC-2	7.5	0	19.9	66.3	0	1346.3	437.7	756.1	0	142.6	2769.0	Chrysophycean flagellates
DC-3	6.1	0	46.4	76.3	13.3	1227.0	192.3	480.8	3.3	59.7	2099.1	Chrysophycean flagellates
DC-4	5.3	0	6.6	6.6	5.0	1212.0	179.1	336.6	0	87.9	1833.8	Chrysophycean flagellates
DC-5	3.8	199.0	5.0	1.7	1.7	1255.2	235.4	208.9	0	84.6	1991.3	Chrysophycean flagellates Flagellates
DC-6	3.1	0	0	51.4	1.7	809.1	238.8	175.8	0	41.5	1318.2	Chrysophycean flagellates Flagellates
NDC-.5-0	9.8	199.0	26.5	126.0	0	1837.1	1094.3	1983.0	6.6	278.6	5551.2	Asterionella formosa Flagellates
NDC-.5-1	8.6	1077.7	16.6	202.3	0	1837.1	507.4	1071.1	0	341.6	5053.8	Flagellates Chrysophycean flagellates
NDC-.5-2	8.0	0	9.9	49.7	0	1154.0	497.4	1366.2	0	149.2	3226.6	Asterionella formosa Chrysophycean flagellates
NDC-1-0	11.4	397.9	33.2	159.2	0	1644.8	795.9	1439.2	0	344.9	4815.0	Flagellates Asterionella formosa Chrysophycean flagellates
NDC-1-1	8.8	663.2	19.9	116.1	0	2215.2	517.3	1638.2	3.3	378.0	5551.2	Flagellates
NDC-1-2	7.3	265.3	9.9	13.3	0	1492.3	218.9	315.0	0	122.7	2437.4	Chrysophycean flagellates
NDC-2-0	9.6	709.7	26.5	59.7	0	1605.0	384.7	968.3	6.6	192.3	3952.8	Chrysophycean flagellates Gomphosphaeria lacustris Flagellates
NDC-2-1	8.4	0	18.2	53.1	0	960.0	424.5	706.3	9.9	157.5	2329.6	Chrysophycean flagellates Asterionella formosa
NDC-2-3	6.3	199.0	11.6	1.7	1.7	865.5	225.5	276.9	0	82.9	1664.7	Chrysophycean flagellates

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
10 APRIL 1981 continued.												
NDC-4-0	9.7	1857.0	46.4	6.6	0	1459.1	749.4	2075.9	0	318.3	6512.9	Anacystis incerta
NDC-4-1	8.3	0	92.9	99.5	0	1130.8	583.6	2155.5	0	66.3	4128.6	Asterionella formosa Synedra ostenfeldii Chrysophycean flagellates
NDC-4-3	5.2	0	5.0	6.6	0	1412.7	271.9	195.7	1.7	0	1893.5	Chrysophycean flagellates
NDC-4-4	3.1	99.5	5.0	358.1	0	926.9	175.8	96.2	1.7	48.1	1711.1	Flagellates
NDC-7-1	8.6	812.5	26.5	112.7	0	1744.3	404.6	1101.0	3.3	208.9	4413.8	Flagellates Anacystis incerta
NDC-7-3	7.4	795.9	3.3	82.9	0	1843.8	447.7	557.1	6.6	139.3	3876.6	Flagellates Anacystis incerta
NDC-7-5	4.5	16.6	3.3	16.6	0	1402.7	160.8	89.5	0	81.2	1770.8	Flagellates
SDC-.5-0	10.3	99.5	13.3	0	0	1777.4	921.9	2566.7	0	112.7	5491.5	Chrysophycean flagellates Flagellates Fragilaria crotonensis Asterionella formosa
SDC-.5-1	8.6	165.8	39.8	39.8	0	1164.0	331.6	523.9	0	285.2	2550.1	Chrysophycean flagellates
SDC-.5-2	7.6	451.0	0	0	0	1349.7	510.7	1044.6	0	59.7	3415.6	Flagellates Chrysophycean flagellates Anacystis incerta
SDC-1-0	10.2	553.8	0	145.9	0	1425.9	1147.4	2981.2	0	152.5	6406.8	Asterionella formosa
SDC-1-1	8.4	0	13.3	116.1	0	2258.3	809.1	2085.8	0	384.7	5667.3	Flagellates Chrysophycean flagellates Asterionella formosa
SDC-1-2	7.1	1071.1	3.3	3.3	0	2022.8	344.9	739.5	0	106.1	4291.1	Flagellates Anacystis incerta
SDC-2-0	10.9	0	26.5	9550.4	0	7693.4	689.8	1618.3	0	12137.0	31715.4	Gloeocystis planctonica
SDC-2-1	8.4	0	9.9	36.5	0	1717.8	487.5	842.3	0	112.7	3206.7	Flagellates Chrysophycean flagellates
SDC-2-3	6.3	0	3.3	16.6	0	1419.3	252.0	437.7	0	82.9	2211.9	Flagellates
SDC-4-0	9.7	0	19.9	13.3	0	1392.8	809.1	1034.6	0	444.4	3714.1	Flagellates
SDC-4-1	8.2	587.0	0	0	0	1777.4	457.6	892.0	0	139.3	3853.3	Chrysophycean flagellates
SDC-4-3	5.2	0	3.3	0	0	1369.6	218.9	301.8	0	73.0	1966.5	Flagellates
SDC-4-4	2.9	0	13.3	9.9	0	1369.6	421.1	182.4	0	53.1	2049.4	Flagellates
SDC-7-1	8.3	305.1	16.6	122.7	6.6	2115.7	603.5	1280.0	0	29.8	4480.1	Chrysophycean flagellates
SDC-7-3	6.6	0	19.9	13.3	0	1581.8	328.3	802.5	0	89.5	2835.3	Flagellates
SDC-7-5	4.5	0	6.6	76.3	0	1674.6	331.6	407.9	0	199.0	2696.0	Chrysophycean flagellates

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
8 JULY 1981												
DC-0	23.8	0	205.6	172.4	0	1737.7	86.2	1187.2	0	26.5	3415.6	Flagellates
DC-1	22.3	0	1535.4	34.8	0	820.7	38.1	38.1	1.7	63.0	2531.9	Anabaena flos-aquae
DC-2	22.7	0	807.5	16.6	1.7	1741.0	6.6	74.6	1.7	31.5	2681.1	Flagellates
DC-3	23.1	0	121.0	31.5	12.4	1043.8	86.2	135.1	0	30.7	1460.8	Flagellates
DC-4	22.4	0	1485.6	0	1.7	928.5	91.2	288.5	0	5.0	2800.5	Anabaena flos-aquae
DC-5	23.6	0	822.4	51.4	0	1487.3	23.2	132.6	3.3	13.3	2533.8	Flagellates
DC-6	23.7	111.1	341.6	91.2	0	994.8	31.5	262.0	1.7	87.9	1921.7	Chrysophycean flagellates Flagellates
NDC-.5-0	25.3	0	1366.2	165.8	0	782.6	285.2	2109.1	0	0	4708.9	Anabaena flos-aquae Fragilaria crotonensis
NDC-.5-1	22.8	0	48.1	21.6	0	1275.1	13.3	213.9	0	24.9	1596.7	Anabaena flos-aquae Flagellates
NDC-.5-2	23.1	0	107.8	29.0	0	578.7	16.6	268.6	0	3.3	1004.0	Flagellates
NDC-1-0	26.5	514.0	1969.8	102.8	13.3	1362.9	179.1	1362.9	0	56.4	5451.7	Anabaena flos-aquae
NDC-1-1	22.4	0	532.2	58.0	0	1056.2	11.6	33.2	0	14.9	1706.1	Flagellates
NDC-1-2	22.2	0	99.5	12.4	0	542.2	25.7	157.5	0	1.7	839.0	Anabaena flos-aquae Flagellates
NDC-2-0	22.3	33.2	651.6	24.9	3.3	378.0	18.2	169.1	0	3.3	1281.7	Anabaena flos-aquae
NDC-2-1	22.8	0	253.7	145.9	0	2002.9	24.9	293.5	0	3.3	2724.2	Flagellates
NDC-2-3	22.5	0	229.6	56.4	5.0	632.6	131.0	224.7	0.8	6.6	1286.7	Flagellates
NDC-4-0	22.1	0	1916.7	13.3	19.9	1213.7	39.8	222.2	0	6.6	3432.2	Anabaena flos-aquae
NDC-4-1	21.9	0	578.7	16.6	1.7	1986.4	26.5	354.8	0	11.6	2976.2	Flagellates
NDC-4-3	21.8	0	102.8	74.6	9.9	1132.5	86.2	54.7	0	16.6	1477.3	Flagellates
NDC-4-4	23.4	11.6	162.5	33.2	0	1119.2	18.2	137.6	0	23.2	1505.5	Flagellates
NDC-7-1	23.7	0	679.8	63.0	6.6	1024.7	164.1	265.3	0	56.4	2259.9	Anabaena flos-aquae Flagellates
NDC-7-3	23.8	0	99.5	116.1	0	1653.1	77.9	87.9	1.7	18.2	2054.3	Flagellates
NDC-7-5	23.2	0	505.7	217.2	0	1840.5	253.7	160.8	5.0	49.7	3032.6	Flagellates
SDC-.5-0	22.1	0	517.3	341.6	0	374.7	112.7	908.6	0	63.0	2318.0	Anabaena flos-aquae Fragilaria crotonensis
SDC-.5-1	23.4	0	709.7	268.6	0	988.2	13.3	376.4	0	21.6	2377.7	Anabaena flos-aquae
SDC-.5-2	23.5	0	316.7	44.8	6.6	805.8	31.5	174.1	0	23.2	1402.7	Flagellates
SDC-1-0	23.2	0	4281.1	464.3	3.3	855.6	112.7	437.7	0	69.6	6224.4	Anabaena flos-aquae

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
8 JULY 1981 continued.												
SDC-1-1	23.4	0	134.3	169.1	0	650.0	13.3	126.0	0	23.2	1115.9	Flagellates
SDC-1-2	24.3	21.6	396.3	308.4	13.3	999.8	94.5	509.0	0	48.1	2390.9	Flagellates Fragilaria crotonensis Anabaena flos-aquae
SDC-2-0	22.1	1392.8	4025.8	623.4	0	3946.2	119.4	955.0	0	0	11062.6	Anabaena flos-aquae
SDC-2-1	23.9	0	147.6	34.8	0	1296.6	24.9	97.8	0	9.9	1611.6	Flagellates
SDC-2-3	23.3	6.6	978.3	43.1	6.6	1104.3	149.2	318.3	0	19.9	2626.4	Anabaena flos-aquae
SDC-4-0	22.3	132.6	636.7	119.4	0	1498.9	112.7	1293.3	0	6.6	3800.3	Flagellates Fragilaria crotonensis
SDC-4-1	24.2	0	3972.7	79.6	0	1114.2	3.3	14.9	0	8.3	5193.0	Anabaena flos-aquae
SDC-4-3	23.8	0	3811.9	825.7	1.7	3014.4	356.5	436.1	5.0	179.1	8630.2	Anabaena flos-aquae
SDC-4-4	23.6	0	393.8	18.2	0	489.1	27.4	202.3	0	29.8	1160.6	Anabaena flos-aquae
SDC-7-1	24.4	0	2245.0	5.0	0	386.3	39.8	131.0	0	24.9	2832.0	Anabaena flos-aquae
SDC-7-3	24.1	99.5	517.3	94.5	5.0	1314.8	102.8	180.7	3.3	34.8	2352.8	Flagellates
SDC-7-5	23.7	0	510.7	51.4	3.3	562.1	19.9	366.4	0	13.3	1527.1	Anabaena flos-aquae
14 OCTOBER 1981												
DC-0	15.5	2566.7	6.6	557.1	13.3	2119.0	925.2	749.4	0	96.2	7033.5	Gomphosphaeria lacustris Rhodomonas minuta
DC-1	14.0	2284.8	69.6	76.3	3.3	2593.2	514.0	719.6	0	341.6	6602.4	Anacystis incerta Flagellates
DC-2	12.0	1608.3	3.3	92.9	0	1754.2	616.8	679.8	0	149.2	4904.5	Gomphosphaeria lacustris
DC-3	12.2	1442.5	6.6	325.0	13.3	2205.2	640.0	1190.5	3.3	295.1	6121.6	Rhodomonas minuta Gomphosphaeria lacustris
DC-4	12.0	474.2	43.1	253.7	0	1872.0	444.4	346.5	0	104.5	3538.3	Rhodomonas minuta
DC-5	12.0	897.0	0	124.4	3.3	1817.2	301.8	281.9	1.7	59.7	3486.9	Flagellates Anacystis incerta
DC-6	12.2	3818.5	195.7	147.6	0	752.8	369.7	343.2	0	86.2	5713.7	Gomphosphaeria lacustris
NDC-.5-0	15.9	1170.6	3.3	281.9	5.0	1469.0	1036.3	633.4	0	182.4	4781.9	Rhodomonas minuta Cyclotella comensis Anacystis incerta
NDC-.5-1	11.9	4092.1	0	86.2	6.6	1996.3	1416.0	842.3	3.3	195.7	8638.5	Anacystis incerta
NDC-.5-2	12.4	4161.7	3.3	424.5	0	3296.2	825.7	931.8	16.6	145.9	9805.8	Anacystis incerta
NDC-1-0	15.8	3415.6	3.3	122.7	0	1542.0	1515.5	776.0	0	199.0	7574.0	Gomphosphaeria lacustris
NDC-1-1	12.0	1445.8	23.2	152.5	3.3	1963.1	424.5	762.7	3.3	179.1	4957.6	Rhodomonas minuta Gomphosphaeria lacustris

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
14 OCTOBER 1981 continued.												
NDC-1-2	12.0	2553.4	215.5	504.1	0	1694.5	1173.9	527.3	0	112.7	6781.5	Gomphosphaeria lacustris
NDC-2-0	15.2	1611.6	53.1	626.7	3.3	2182.0	722.9	587.0	0	640.0	6426.6	Rhodomonas minuta Flagellates
NDC-2-1	12.5	855.6	126.0	344.9	0	2261.6	895.4	829.0	0	199.0	5511.4	Anacystis incerta Flagellates
NDC-2-3	12.0	1760.9	0	136.0	0	1223.7	883.7	489.1	0	64.7	4558.0	Cyclotella comensis Rhodomonas minuta Gomphosphaeria lacustris Gomphosphaeria lacustris
NDC-4-0	15.8	2453.9	0	315.0	0	835.7	679.8	358.1	0	92.9	4735.4	Rhodomonas minuta Anacystis incerta Anacystis incerta
NDC-4-1	12.0	391.3	9.9	175.8	0	1293.3	470.9	159.2	3.3	142.6	2646.3	Rhodomonas minuta
NDC-4-3	12.2	1673.0	1.7	257.0	0	1868.6	427.8	200.6	0	140.9	4569.6	Gomphosphaeria lacustris
NDC-4-4	12.0	664.9	0	205.6	0	845.6	286.8	157.5	0	61.3	2221.8	Rhodomonas minuta
NDC-7-1	11.8	4765.3	3.3	202.3	3.3	2205.2	1180.5	822.4	0	149.2	9331.6	Anacystis incerta Gomphosphaeria lacustris
NDC-7-3	11.6	2135.6	0	288.5	0	2361.1	911.9	563.7	0	318.3	6579.2	Anacystis incerta Gomphosphaeria lacustris
NDC-7-5	12.0	2908.2	0	132.6	0	1736.0	388.0	334.9	0	114.4	5614.2	Rhodomonas minuta Gomphosphaeria lacustris
SDC-.5-0	15.2	1077.7	6.6	245.4	0	2095.8	603.5	361.5	0	155.9	4546.4	Anacystis incerta Rhodomonas minuta
SDC-.5-1	12.0	663.2	49.7	73.0	0	2122.3	658.3	330.0	1.7	187.4	4085.5	Gomphosphaeria lacustris Rhodomonas minuta
SDC-.5-2	12.1	1608.3	0	69.6	0	1482.3	817.4	235.4	0	68.0	4281.1	Gomphosphaeria lacustris
SDC-1-0	15.2	1067.8	46.4	126.0	3.3	1883.6	431.1	573.7	3.3	145.9	4281.1	Rhodomonas minuta Rhodomonas minuta
SDC-1-1	12.2	1193.8	0	149.2	6.6	2944.7	722.9	447.7	0	199.0	5663.9	Rhodomonas minuta Flagellates
SDC-1-2	12.2	245.4	0	182.4	1.7	1968.1	510.7	301.8	3.3	152.5	3365.9	Gomphosphaeria lacustris Rhodomonas minuta
SDC-2-0	15.1	557.1	0	112.7	0	1525.4	1150.7	301.8	0	73.0	3720.7	Rhodomonas minuta
SDC-2-1	12.0	893.7	9.9	71.3	0	1659.7	509.0	225.5	1.7	202.3	3573.1	Rhodomonas minuta
SDC-2-3	12.0	746.1	49.7	77.9	3.3	1566.9	525.6	271.9	0	74.6	3316.1	Rhodomonas minuta
SDC-4-0	14.0	716.3	0	119.4	6.6	1979.7	875.5	610.2	6.6	182.4	4496.7	Flagellates
SDC-4-1	11.7	809.1	0	185.7	3.3	1684.6	514.0	567.1	0	175.8	3939.6	Rhodomonas minuta
SDC-4-3	12.2	673.2	0	56.4	0	1104.3	207.3	174.1	0	68.0	2283.2	Rhodomonas minuta

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
14 OCTOBER 1981 continued.												
SDC-4-4	12.0	1016.4	49.7	99.5	0	679.8	263.6	41.5	0	33.2	2183.7	Anacystis incerta
SDC-7-1	11.2	893.7	3.3	353.2	1.7	1127.5	422.8	417.8	0	136.0	3355.9	Rhodomonas minuta Anacystis incerta
SDC-7-3	12.0	605.2	0	68.0	0	1256.8	386.3	122.7	0	64.7	2503.7	Rhodomonas minuta
SDC-7-5	12.0	354.8	3.3	73.0	0	890.4	215.5	49.7	0	36.5	1623.2	Rhodomonas minuta
15 APRIL 1982												
DC-0	6.1	0	13.3	66.3	0	1333.1	2002.9	1525.4	0	152.5	5093.6	Unknown centric diatom Fragilaria crotonensis Stephanodiscus subtilis
DC-1	10.2	0	0	86.2	0	1280.0	1299.9	537.2	0	258.7	3462.0	Chrysophycean flagellates Stephanodiscus minutus
DC-2	7.1	0	9.9	26.5	0	1336.4	1203.8	1107.6	0	288.5	3972.7	Fragilaria crotonensis Flagellates
DC-3	6.2	0	6.6	26.5	0	1777.4	981.6	948.4	0	86.2	3826.8	Chrysophycean flagellates
DC-4	3.2	6.6	13.3	53.1	0	1124.2	474.2	467.6	0	69.6	2208.5	Chrysophycean flagellates
DC-5	3.0	170.8	1.7	16.6	0	512.3	278.6	301.8	0	19.9	1301.6	Chrysophycean flagellates Gomphosphaeria lacustris
DC-6	1.2	238.8	0	122.7	6.6	1117.5	175.8	305.1	0	26.5	1993.0	Rhodomonas minuta Flagellates
NDC-.5-0	5.9	0	19.9	126.0	0	888.7	1923.4	1306.6	0	192.3	4456.9	Unknown centric diatom
NDC-.5-1	6.4	0	6.6	271.9	6.6	1996.3	1777.4	1996.3	0	258.7	6313.9	Flagellates
NDC-.5-2	4.4	1694.5	9.9	82.9	26.5	4191.6	1797.3	2115.7	0	394.6	10313.1	Chrysophycean flagellates
NDC-1-0	6.0	26.5	19.9	39.8	0	1472.4	2699.3	3395.7	0	291.8	7945.4	Stephanodiscus subtilis Tabellaria fenestrata v. intermedia
NDC-1-1	5.1	132.6	36.5	39.8	0	1717.8	1551.9	1724.4	3.3	262.0	5468.3	Fragilaria crotonensis Fragilaria crotonensis Chrysophycean flagellates
NDC-1-2	4.1	0	19.9	23.2	6.6	1721.1	965.0	921.9	0	162.5	3820.2	Chrysophycean flagellates
NDC-2-0	6.9	0	192.3	36.5	49.7	1270.1	1757.5	1087.7	0	155.9	4549.7	Unknown centric diatom
NDC-2-1	5.2	179.1	9.9	139.3	29.8	2948.0	2211.9	1542.0	0	262.0	7322.0	Chrysophycean flagellates
NDC-2-3	3.5	0	258.7	271.9	0	1200.4	703.0	971.6	0	63.0	3468.7	Chrysophycean flagellates
NDC-4-0	6.9	0	16.6	276.9	0	1258.5	2142.2	986.5	0	436.1	5116.8	Fragilaria crotonensis Stephanodiscus minutus Stephanodiscus sp.
NDC-4-1	4.8	0	6.6	132.6	0	1386.1	1956.5	1465.7	0	92.9	5040.5	Unknown centric diatom Fragilaria crotonensis
NDC-4-3	3.9	0	0	53.1	3.3	1014.7	427.8	868.8	3.3	63.0	2434.0	Chrysophycean flagellates Fragilaria crotonensis

TABLE 2 continued.

Station	Temperature	Coccoid blue-greens	Filamentous blue-greens	Coccoid greens	Filamentous greens	Flagellates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae	Dominant species
15 APRIL 1982 continued.												
NDC-4-4	1.2	0	3.3	13.3	0	981.6	311.7	232.1	0	39.8	1581.8	Chrysophycean flagellates Rhodomonas minuta
NDC-7-1	5.6	0	6.6	73.0	0	1379.5	1784.1	809.1	6.6	238.8	4297.7	Unknown centric diatom Chrysophycean flagellates
NDC-7-3	3.6	0	14.9	19.9	0	1387.8	1110.9	588.6	0	194.0	3316.1	Chrysophycean flagellates Stephanodiscus minutus Ochromonas sp.
NDC-7-5	2.1	3.3	3.3	18.2	0	1364.6	266.9	210.6	0	34.8	1901.8	Chrysophycean flagellates
SDC-.5-0	5.9	0	6.6	258.7	0	1459.1	3634.5	2075.9	0	451.0	7885.7	Stephanodiscus sp. Stephanodiscus subtilis Stephanodiscus minutus
SDC-.5-1	5.3	33.2	16.6	64.7	0	1865.3	1190.5	868.8	3.3	391.3	4433.7	Chrysophycean flagellates
SDC-.5-2	5.4	66.3	26.5	99.5	36.5	2835.3	1329.8	1326.5	0	325.0	6045.3	Chrysophycean flagellates
SDC-1-0	5.9	172.4	0	4563.0	26.5	5465.0	3117.2	1485.6	0	1207.1	16036.8	Gloeocystis planctonica
SDC-1-1	4.9	961.7	6.6	73.0	0	1717.8	1084.4	722.9	0	139.3	4705.6	Anacystis incerta Chrysophycean flagellates
SDC-1-2	4.6	0	3.3	13.3	73.0	1061.2	646.6	855.6	0	119.4	2772.3	Chrysophycean flagellates
SDC-2-0	6.5	0	6.6	1578.5	0	1260.1	1750.9	1757.5	0	285.2	6638.9	Gloeocystis planctonica
SDC-2-1	5.8	0	13.3	56.4	16.6	1605.0	1382.8	815.8	0	374.7	4264.5	Chrysophycean flagellates Stephanodiscus minutus
SDC-2-3	4.6	0	3.3	215.5	33.2	2102.4	1180.5	1578.5	0	265.3	5378.8	Chrysophycean flagellates
SDC-4-0	6.2	0	79.6	86.2	6.6	1518.8	1949.9	1230.3	3.3	431.1	5305.8	Chrysophycean flagellates Fragilaria crotonensis
SDC-4-1	5.8	0	3.3	86.2	0	1240.2	1343.0	1210.4	0	311.7	4194.9	Chrysophycean flagellates Unknown centric diatom
SDC-4-3	3.9	0	16.6	0	0	1014.7	663.2	1061.2	0	23.2	2778.9	Chrysophycean flagellates Fragilaria crotonensis
SDC-4-4	1.3	0	3.3	56.4	3.3	2453.9	232.1	271.9	0	46.4	3067.4	Chrysophycean flagellates
SDC-7-1	5.2	199.0	13.3	46.4	0	1472.4	1817.2	1114.2	0	431.1	5093.6	None
SDC-7-3	3.6	0	6.6	11.6	0	538.9	343.2	625.1	0	16.6	1542.0	Chrysophycean flagellates Fragilaria crotonensis
SDC-7-5	3.1	290.2	9.9	13.3	6.6	1692.9	474.2	603.5	0	39.8	3130.4	Chrysophycean flagellates

TABLE 3. The dominant and codominant phytoplankters in the Cook Plant seasonal surveys of preoperational 1970 through 1974 and operational 1975 through April 1982.

Survey	Species or group	Dominant or codominant occurrences
10 July 1970	Tabellaria fenestrata (diatom)	40
	Cyclotella sp. (diatom)	9
	Fragilaria crotonensis (diatom)	7
	Melosira sp. (diatom)	3
	Dinobryon divergens (flagellate)	2
	Flagellates	2
	Melosira granulata (diatom)	2
	Melosira granulata v. angustissima (diatom)	2
	Oocystis solitaria (green)	2
	Anabaena circinalis (blue-green)	1
	Chlamydomonas sp. (flagellate)	1
	Microcystis aeruginosa (blue-green)	1
	Melosira islandica (diatom)	1
	Melosira italica (diatom)	1
25 Sept 1970	Chlamydomonas sp. (flagellate)	28
	Fragilaria crotonensis (diatom)	13
	Dinobryon divergens (flagellate)	10
	Oocystis sp. (green)	10
	Gloeocystis sp. (green)	7
	Melosira granulata (diatom)	7
	Chroococcus limneticus (blue-green)	4
	Ochromonas sp. (flagellate)	3
	Melosira granulata v. angustissima (diatom)	2
	Peridinium sp. (flagellate)	2
	Closteriopsis sp. ("other" alga*)	1
	Cryptomonas sp. (flagellate)	1
	Cyclotella sp. (diatom)	1
	Tabellaria fenestrata (diatom)	1
	Tetraedron minimum ("other" alga*)	1
12 Nov 1970	Ochromonas sp. (flagellate)	33
	Chlamydomonas sp. (flagellate)	19
	Cryptomonas sp. (flagellate)	3
	Fragilaria crotonensis (diatom)	3
	Crucigenia rectangularis ("other" alga*)	1
	Cyclotella sp. (diatom)	1

(continued)

TABLE 3. Continued.

Survey	Species or group	Dominant or codominant occurrences
15 April 1971	Ochromonas sp. (flagellate)	24
	Melosira sp. (diatom)	15
	Chlamydomonas sp. (flagellate)	15
	Tabellaria fenestrata (diatom)	14
	Stephanodiscus sp. (diatom)	13
	Fragilaria crotonensis (diatom)	9
	Cyclotella sp. (diatom)	6
	Fragilaria sp. (diatom)	1
9 July 1971	Gloeocystis sp. (green)	47
	Oocystis sp. (green)	18
	Glenodinium sp. (flagellate)	12
	Dinobryon divergens (flagellate)	10
	Tabellaria fenestrata (diatom)	8
	Cyclotella sp. (diatom)	4
	Fragilaria crotonensis (diatom)	3
	Scenedesmus sp. ("other" alga*)	1
	Crucigenia sp. ("other" alga*)	1
	Fragilaria sp. (diatom)	1
	Westella linearis (green)	1
8 Nov 1971	Ochromonas sp. (flagellate)	20
	Tabellaria fenestrata (diatom)	17
	Fragilaria crotonensis (diatom)	7
	Gloeocystis sp. (green)	6
	Chlamydomonas sp. (flagellate)	4
	Cryptomonas sp. (flagellate)	3
	Aphanothece sp. (blue-green)	2
	Oocystis sp. (green)	1
	Fragilaria sp. (diatom)	1
12 April 1972	Tabellaria fenestrata (diatom)	13
	Chlamydomonas sp. (flagellate)	8
	Cyclotella sp. (diatom)	7
	Stephanodiscus sp. (diatom)	6
	Gloeocystis sp. (green)	4

(continued)

TABLE 3. Continued.

Survey	Species or group	Dominant or codominant occurrences
16 July 1972	Tabellaria fenestrata (diatom)	14
	Gloeocystis sp. (green)	5
	Chlamydomonas sp. (flagellate)	5
	Fragilaria intermedia (diatom)	4
	Fragilaria capucina (diatom)	4
	Fragilaria crotonensis (diatom)	3
	Dinobryon sp. (flagellate)	3
	Flagellates	2
	Anabaena sp. (blue-green)	2
	Glenodinium sp. (flagellate)	1
	Oocystis sp. (green)	1
15 Oct 1972	Melosira granulata (diatom)	26
	Chroococcus limneticus (blue-green)	4
	Flagellates	3
	Chroococcussp. (blue-green)	2
25 April 1973	Stephanodiscus minutus (diatom)	21
	Flagellates	12
	Cyclotella sp. (diatom)	5
	Stephanodiscus sp. (diatom)	3
	Fragilaria crotonensis (diatom)	1
	Gloeocystis sp. (green)	1
	Chlamydomonassp. (flagellate)	1
	Melosira granulata (diatom)	1
	Tabellaria fenestrata v. intermedia (diatom)	1
19 July 1973	Stephanodiscus tenuis (diatom)	19
	Cyclotella stelligera (diatom)	10
	Melosira granulata v. angustissima (diatom)	4
	Chlamydomonas sp. (flagellate)	4
	Cyclotella sp. (diatom)	2
	Cyclotella atomus (diatom)	1
	Anacystis incerta (blue-green)	1
	Flagellates	1
	Gloeocystis sp. (green)	1
	Coccomyxa coccoides (green)	1
23 Oct 1973	Melosira granulata v. angustissima (diatom)	20
	Flagellates	9
	Chlamydomonas sp. (flagellate)	3
	Fragilaria crotonensis (diatom)	2
	Melosira granulata (diatom)	1

(continued)

TABLE 3. Continued.

Survey	Species or group	Dominant or codominant occurrences
20 April 1974	Fragilaria crotonensis (diatom)	20
	Flagellates	18
	Stephanodiscus tenuis (diatom)	11
	Synedra filiformis (diatom)	3
	Fragilaria intermedia v. fallax (diatom)	1
	Melosira granulata (diatom)	1
	Melosira italica (diatom)	1
	Stephanodiscus minutus (diatom)	1
11 July 1974	Fragilaria crotonensis (diatom)	27
	Flagellates	21
	Anacystis incerta (blue-green)	2
	Anabaena flos-aquae (blue-green)	1
	Cyclotella stelligera (diatom)	1
	Tabellaria fenestrata v. intermedia (diatom)	1
	Thalassiosira pseudonana (diatom)	1
	Stephanodiscus tenuis (diatom)	1
9 Oct 1974	Anacystis incerta (blue-green)	22
	Flagellates	21
	Gomphosphaeria lacustris (blue-green)	11
	Anacystis thermalis (blue-green)	3
	Fragilaria crotonensis (diatom)	2
	Asterionella formosa (diatom)	1
	Melosira granulata (diatom)	1
	Stephanodiscus minutus (diatom)	1
	Stephanodiscus tenuis (diatom)	1
17 April 1975	Flagellates	24
	Stephanodiscus tenuis (diatom)	17
	Fragilaria crotonensis (diatom)	15
	Stephanodiscus minutus (diatom)	8
	Cyclotella stelligera (diatom)	7
	Tabellaria flocculosa (diatom)	3
	Tabellaria fenestrata v. intermedia (diatom)	1
	Melosira islandica (diatom)	1
	Anacystis incerta (blue-green)	1
	Fragilaria capucina (diatom)	1
	Fragilaria intermedia (diatom)	1
	Synedra filiformis (diatom)	1

(continued)

TABLE 3. Continued.

Survey	Species or group	Dominant or codominant occurrences
17 July 1975	Gloeocystis sp. (green)	20
	Flagellates	15
	Anabaena flos-aquae (blue-green)	10
	Green coccoid unknown	4
	Fragilaria crotonensis (diatom)	1
	Cyclotella stelligera (diatom)	1
	Gloeocystis planctonica (green)	1
17 Oct 1975	Anacystis incerta (blue-green)	22
	Gomphosphaeria lacustris (blue-green)	15
	Fragilaria crotonensis (diatom)	9
	Flagellates	5
	Anabaena flos-aquae (blue-green)	1
	Gloeocystis sp. (green)	1
	Ochromonas sp. (flagellate)	1
	Synedra filiformis (diatom)	1
14 April 1976	Flagellates	23
	Fragilaria crotonensis (diatom)	18
	Asterionella formosa (diatom)	16
	Stephanodiscus sp. (diatom)	8
	Anacystis incerta (blue-green)	4
	Stephanodiscus subtilis (diatom)	4
	Rhizosolenia gracilis (diatom)	2
	Stephanodiscus minutus (diatom)	2
	Gomphosphaeria lacustris (blue-green)	1
	Ulothrix sp. (green)	1
14 July 1976	Flagellates	24
	Gloeocystis sp. (green)	12
	Anabaena flos-aquae (blue-green)	9
	Gomphosphaeria lacustris (blue-green)	4
	Anacystis incerta (blue-green)	2
	Cyclotella stelligera (diatom)	2
	Fragilaria crotonensis (diatom)	2
	Gloeocystis planctonica (green)	1
	Oocystis sp. (green)	1
	Pediastrum duplex ("other" alga*)	1

(continued)

TABLE 3. Continued.

Survey	Species or group	Dominant or codominant occurrences
14 Oct 1976	Flagellates	28
	Fragilaria crotonensis (diatom)	11
	Gomphosphaeria lacustris (blue-green)	8
	Anacystis incerta (blue-green)	6
	Cyclotella comensis (diatom)	5
	Gloeocystis sp. (green)	5
	Anabaena flos-aquae (blue-green)	1
	Gloeocystis planctonica (green)	1
	Melosira granulata (diatom)	1
14 April 1977	Flagellates	24
	Ochromonas sp. (flagellate)	19
	Fragilaria crotonensis (diatom)	13
	Synedra ostenfeldii (diatom)	5
	Synedra filiformis (diatom)	2
	Anacystis incerta (blue-green)	1
	Cyclotella stelligera (diatom)	1
13 July 1977	Fragilaria crotonensis (diatom)	15
	Cyclotella comensis (diatom)	15
	Anabaena flos-aquae (blue-green)	11
	Flagellates	6
	Cyclotella sp. (diatom)	5
	Anacystis incerta (blue-green)	3
	Cyclotella michiganiana (diatom)	3
14 Oct 1977	Anacystis incerta (blue-green)	24
	Gomphosphaereia lacustris (blue-green)	12
	Flagellates	10
	Fragilaria crotonensis (diatom)	6
	Melosira granulata (diatom)	2
	Agmenellum quadruplicatum (blue-green)	1
14 April 1978	Flagellates	34
	Ochromonas sp. (flagellate)	11
	Stephanodiscus sp. #5 (diatom)	6
	Stephanodiscus sp. (diatom)	5
	Fragilaria crotonensis (diatom)	4
	Asterionella formosa (diatom)	3
	Unknown coccoid green	3
	Anacystis incerta (blue-green)	2

(continued)

TABLE 3. Continued.

Survey	Species or group	Dominant or codominant occurrences
12 July 1978	Flagellates	31
	Fragilaria crotonensis (diatom)	13
	Melosira granulata (diatom)	8
	Anacystis incerta (blue-green)	8
	Tabellaria fenestrata v. intermedia (diatom)	6
	Anabaena flos-aquae (blue-green)	2
	Anacystis cyanea (blue-green)	1
	Stephanodiscus sp. (diatom)	1
11 Oct 1978	Anacystis incerta (blue-green)	37
	Gomphosphaeria lacustris (blue-green)	7
	Melosira granulata (diatom)	3
	Flagellates	1
	Rhodomonas minuta (flagellate)	1
12 April 1979	Stephanodiscus hantzschii (diatom)	24
	Asterionella formosa (diatom)	19
	Stephanodiscus sp. (diatom)	11
	Flagellates	4
	Ochromonas sp. (flagellate)	3
	Gomphosphaeria lacustris (blue-green)	1
	Anacystis incerta (blue-green)	1
	Stephanodiscus alpinus (diatom)	1
11 July 1979	Anabaena flos-aquae (blue-green)	25
	Flagellates	20
	Fragilaria crotonensis (diatom)	3
18 Oct 1979	Anacystis incerta (blue-green)	27
	Melosira granulata (diatom)	8
	Flagellates	3
	Gomphosphaeria lacustris (blue-green)	3
	Stephanodiscus tenuis (diatom)	2
	Fragilaria crotonensis (diatom)	1
	Rhodomonas minuta (flagellate)	1
10 April 1980	Flagellates	27
	Rhodomonas minuta (flagellate)	17
	Asterionella formosa (diatom)	13
	Stephanodiscus minutus (diatom)	7
	Fragilaria crotonensis (diatom)	3
	Unknown green colony	1
	Gomphosphaeria lacustris (blue-green)	1
	Anacystis incerta (blue-green)	1
	Gloecystis sp. (green)	1

(continued)

TABLE 3. Concluded.

Survey	Species or group	Dominant or codominant occurrences
9 July 1980	Flagellates	21
	Fragilaria crotonensis (diatom)	19
	Asterionella formosa (diatom)	15
	Anacystis incerta (blue-green)	10
	Anabaena flos-aquae (blue-green)	8
	Gomphosphaeria lacustris (blue-green)	1
15 Oct 1980	Anacystis incerta (blue-green)	29
	Gomphosphaeria lacustris (blue-green)	14
	Flagellates	5
	Cyclotella comensis (diatom)	2
	Rhodomonas minuta (flagellate)	2
	Unknown blue-green colony	1
10 April 1981	Flagellates	45
	Asterionella formosa (diatom)	9
	Anacystis incerta (blue-green)	6
	Gomphosphaeria lacustris (blue-green)	1
	Synedra ostenfeldii (diatom)	1
	Fragilaria crotonensis (diatom)	1
	Gloeocystis planctonica (green)	1
8 July 1981	Flagellates	24
	Anabaena flos-aquae (blue-green)	20
	Fragilaria crotonensis (diatom)	4
14 Oct 1981	Rhodomonas minuta (flagellate)	25
	Gomphosphaeria lacustris (blue-green)	16
	Anacystis incerta (blue-green)	13
	Flagellates	6
	Cyclotella comensis (diatom)	2
15 April 1982	Flagellates	29
	Fragilaria crotonensis (diatom)	10
	Unknown centric diatom	6
	Stephanodiscus minutus (diatom)	5
	Stephanodiscus subtilis (diatom)	3
	Rhodomonas minuta (flagellate)	2
	Stephanodiscus sp. (diatom)	2
	Gloeocystis planctonica (green)	2
	Gomphosphaeria lacustris (blue-green)	1
	Tabellaria fenestrata v. intermedia	1
	Ochromonas sp. (flagellate)	1
	Anacystis incerta (blue-green)	1

*A green alga, but coded as "other" because it is neither filamentous nor coccoid.

numbers of their dominant or codominant occurrences given. This is done to assist the reader in sorting the probably important dominants and codominants from the rare ones which might be due to the chance capture of a single many-celled filament or colony.

Beginning in 1972 there has been a trend toward increasing numbers of cases of dominance or codominance by blue-green algae. Heavy dominance by the blue-greens Anacystis incerta and Gomphosphaeria lacustris first appeared in October 1974 and has been characteristic of Octobers in subsequent years; moderate to heavy dominance by Anabaena flos-aquae began in July of 1975 and has been typical of Julys in following years. These dominances are consistent with the findings by Tarapchak and Stoermer (1976) and others that in recent years blue-greens have increased in Lake Michigan as a result of summer and fall depletion of silica in the epilimnion; being lake-caused, the more frequent dominances by blue-greens cannot be attributed to Cook Plant operation.

Master Lists of Phytoplankters Collected

Appendix C presents the lists of phytoplankters collected in the seasonal surveys of 1980, 1981, and April 1982. Ayers and Feldt (1982) give the lists of those collected in 1978 and 1979. Ayers and Wiley (1979) list the collections of 1977. Ayers (1978) lists the collections of 1976 and previously unreported September 1970. Ayers, Southwick, and Robinson (1977) give the master lists for the surveys of 1974 and 1975. Ayers (1975) presents the lists for the surveys of 1972 and 1973. Ayers, Mozley, and Stewart (1974) list the species collected in the seasonal surveys of 1971. Ayers, Mozley, and Roth (1973) give the master list for November 1970. Ayers et al. (1971) list the species taken in the July survey of 1970.

Establishment of Cyclotella comensis

The centric diatom, Cyclotella comensis, previously not found in Cook Plant area phytoplankton samples, first occurred in the collections of October 1975 and has been taken in each seasonal survey since then. Since October 1976 it has been present in 74-100% of our station samples. Blooming in late summer and fall, it is most apt to become a dominant in October but is present at low levels at other times.

Inner-Outer Graphical Comparisons: Diversity Indices

Cook Plant species diversity data for the years 1971 through 1977 have been presented by Ayers, Southwick, and Robinson (1977), Ayers (1978), Ayers and Wiley (1979), and Ayers and Feldt (1982); this section extends those reports to include the seasonal surveys of 1980, 1981, and April 1982.

As was done previously, the diversity index data have been stratified by three depth zones and by inner treatment stations (near the plant) and outer control or reference stations groups. The diversity index used is, as previously, that of Wilhm and Dorris (1968):

$$\bar{d} = - \sum_{i=1}^{S} (n_i/n) \log_2 (n_i/n)$$

where S is the number of species, n is the total number of phytoplankton in cells/mL, n_i is the number of phytoplankton of the i^{th} species.

Mean diversity indices and associated standard errors for each depth-zone-station-group combination in 1980-82 have been computed and are presented in Table 4. In Figure 2 the surveys of 1980-82 have been added at the end of the time plots of diversity indices and standard errors which were presented by Ayers and Feldt (1982).

TABLE 4. Means, standard errors, and numbers of observations of phytoplankton diversity indices by seasons, depth zones, and inner or outer station groups in Cook Plant major surveys during operational 1980. The diversity index used is that of Wilhm and Dorris (1968) based on log 2. Standard errors are computed only when the number of observations is two or more.

1980		10 April	8 July	15 October
Zone 0	Inner			
	Mean	4.30	3.98	3.88
	S. E.	0.07	0.12	0.13
	N	12	12	12
	Outer			
	Mean	4.36	3.95	3.83
	S. E.	0.07	0.15	0.13
	N	10	10	10
Zone 1	Inner			
	Mean	4.29	3.61	3.18
	S. E.	0.10	0.18	0.34
	N	3	3	3
	Outer			
	Mean	3.97	3.56	3.96
	S. E.	0.14	0.14	0.11
	N	4	4	4
Zone 2	Inner			
	Mean	4.16	3.49	3.03
	S. E.	0.23	0.09	0.40
	N	2	2	2
	Outer			
	Mean	4.13	3.55	3.04
	S. E.	0.09	0.29	1.08
	N	4	4	4

(continued)

TABLE 4. Continued.

1981		10 April	8 July	14 October
Zone 0	Inner			
	Mean	4.25	2.96	3.63
	S. E.	0.08	0.16	0.07
	N	12	12	12
	Outer			
	Mean	3.99	2.41	3.76
	S. E.	0.12	0.24	0.14
	N	10	10	10
Zone 1	Inner			
	Mean	3.48	2.89	3.52
	S. E.	0.17	0.44	0.18
	N	3	3	3
	Outer			
	Mean	3.66	2.97	3.74
	S. E.	0.14	0.21	0.11
	N	4	4	4
Zone 2	Inner			
	Mean	3.19	2.98	3.82
	S. E.	0.18	0.58	0.05
	N	2	2	2
	Outer			
	Mean	3.31	3.01	3.61
	S. E.	0.28	0.21	0.04
	N	4	4	4

(continued)

TABLE 4. Concluded.

1982		15 April
Zone 0	Inner	
	Mean	3.97
	S. E.	0.08
	N	12
	Outer	
	Mean	4.15
	S. E.	0.04
	N	10
Zone 1	Inner	
	Mean	4.19
	S. E.	0.09
	N	3
	Outer	
	Mean	4.09
	S. E.	0.09
	N	4
Zone 2	Inner	
	Mean	4.00
	S. E.	0.11
	N	2
	Outer	
	Mean	3.59
	S. E.	0.30
	N	4

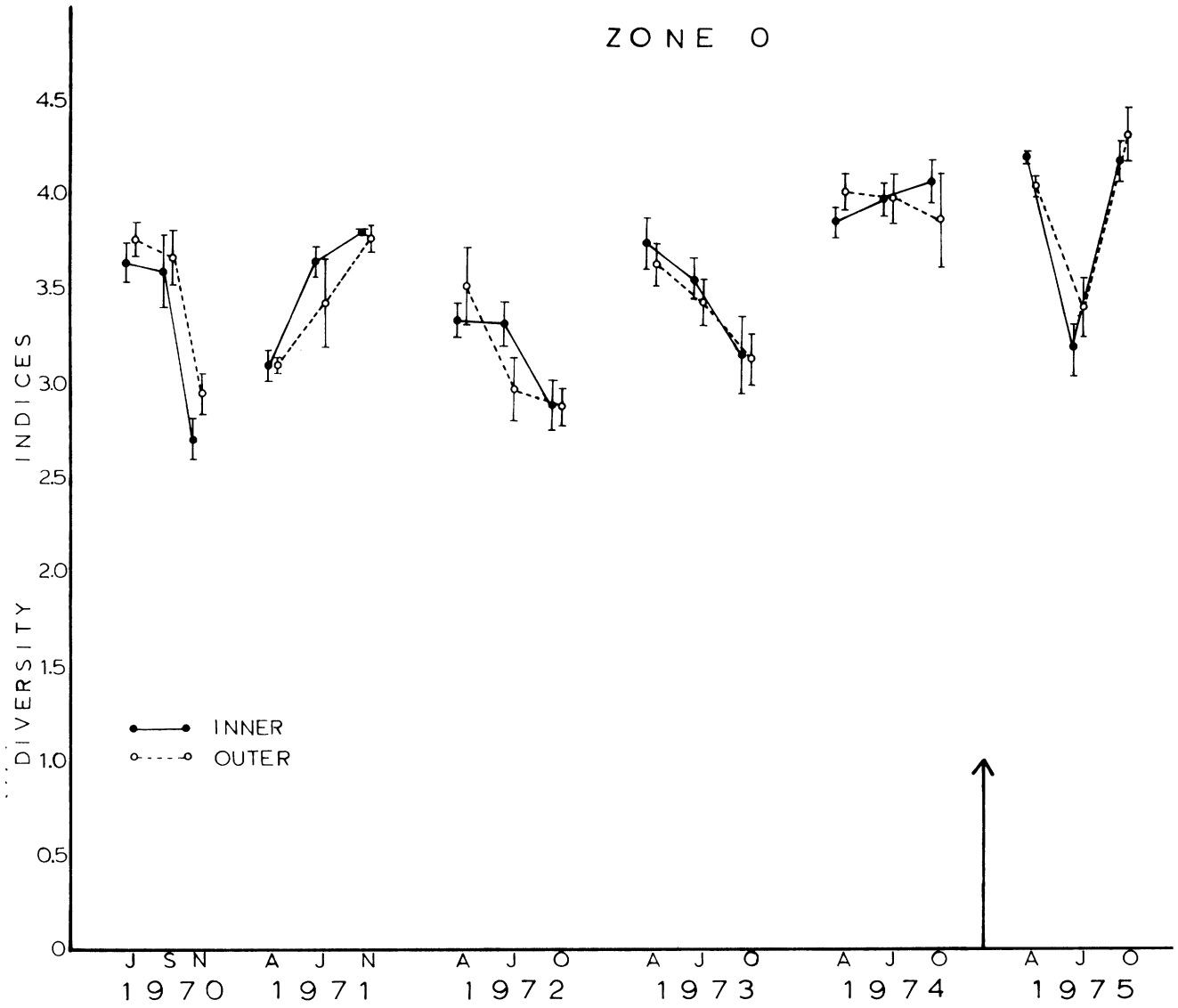
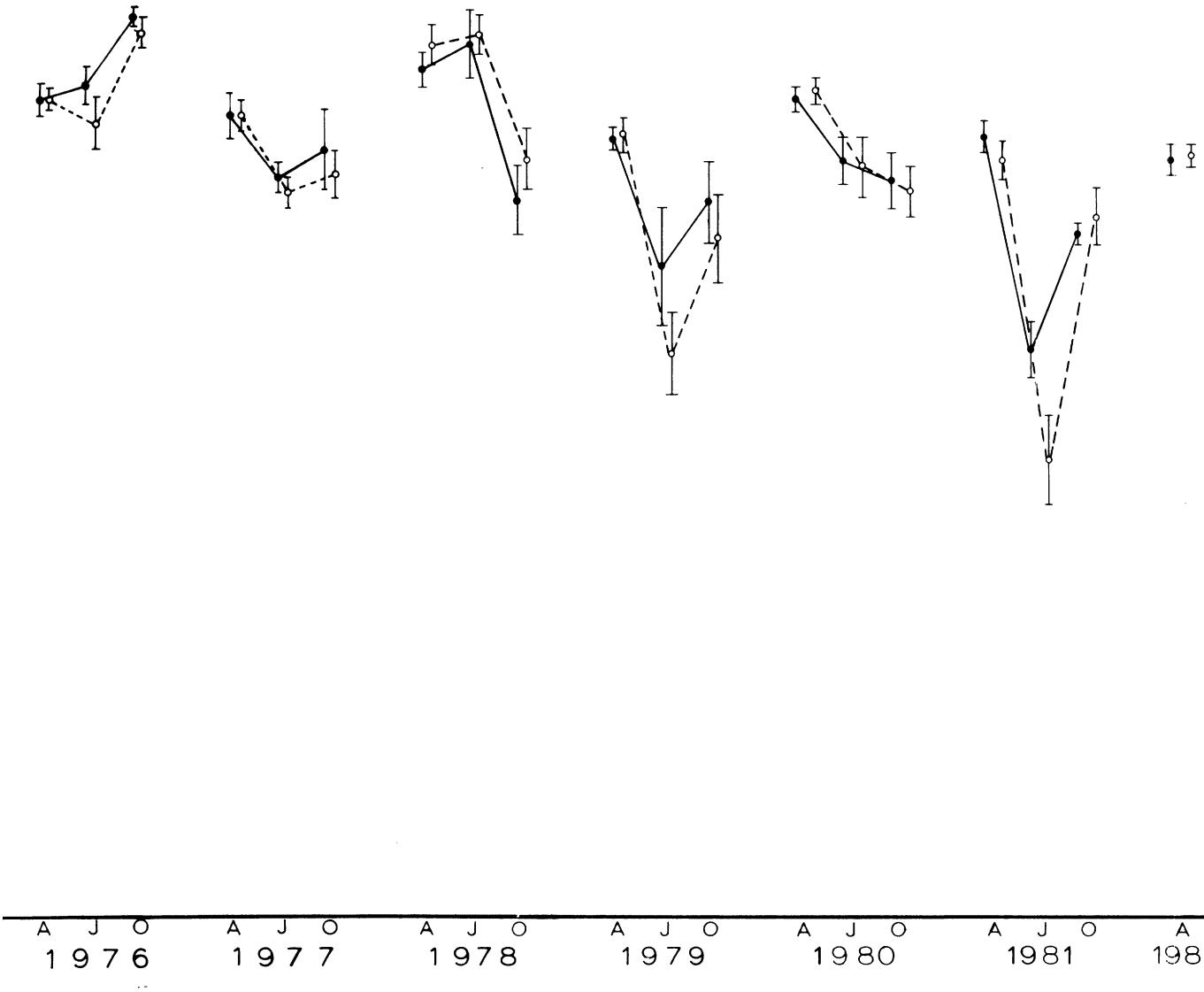


FIG. 2A. Mean diversity indices in zone 0 by spring, summer, and fall seasons and inner and outer station groups in 1970 through 1982. The vertical bars show the standard errors. See Table 4 for numbers of observations.


A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

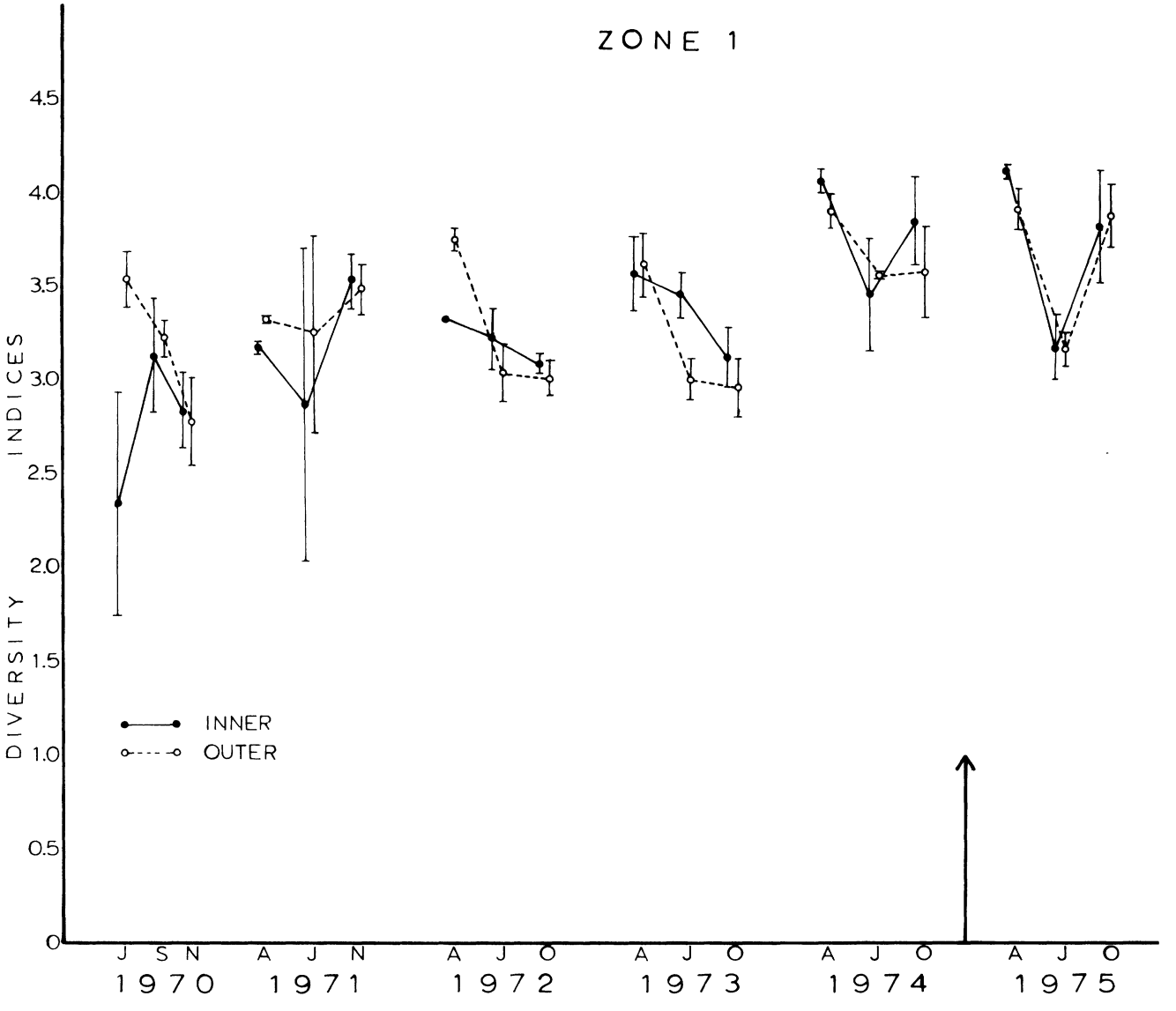
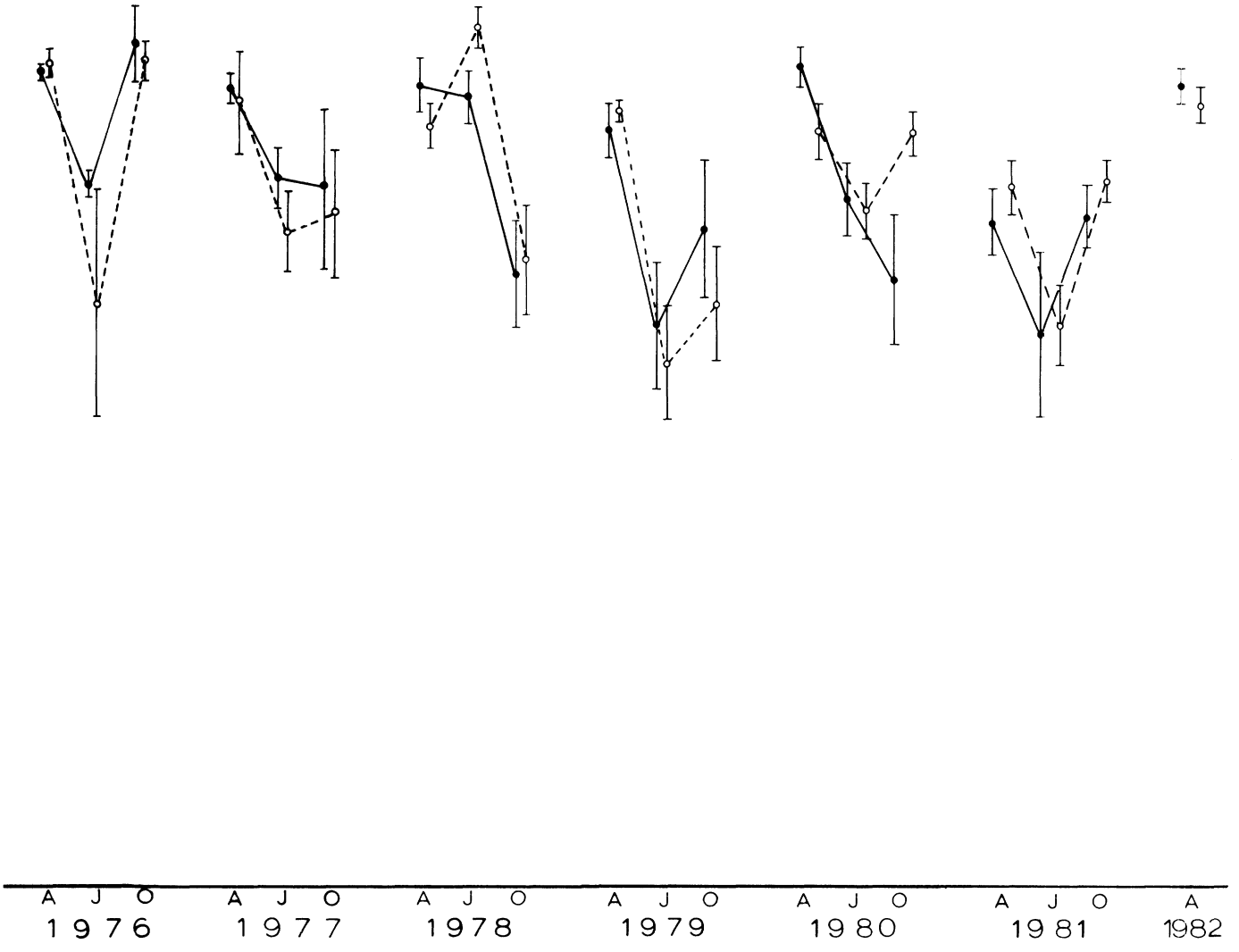


FIG. 2B. Mean diversity indices in zone 1 by spring, summer, and fall seasons and inner and outer station groups in 1970 through 1982. The vertical bars show the standard errors. See Table 4 for numbers of observations.


A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

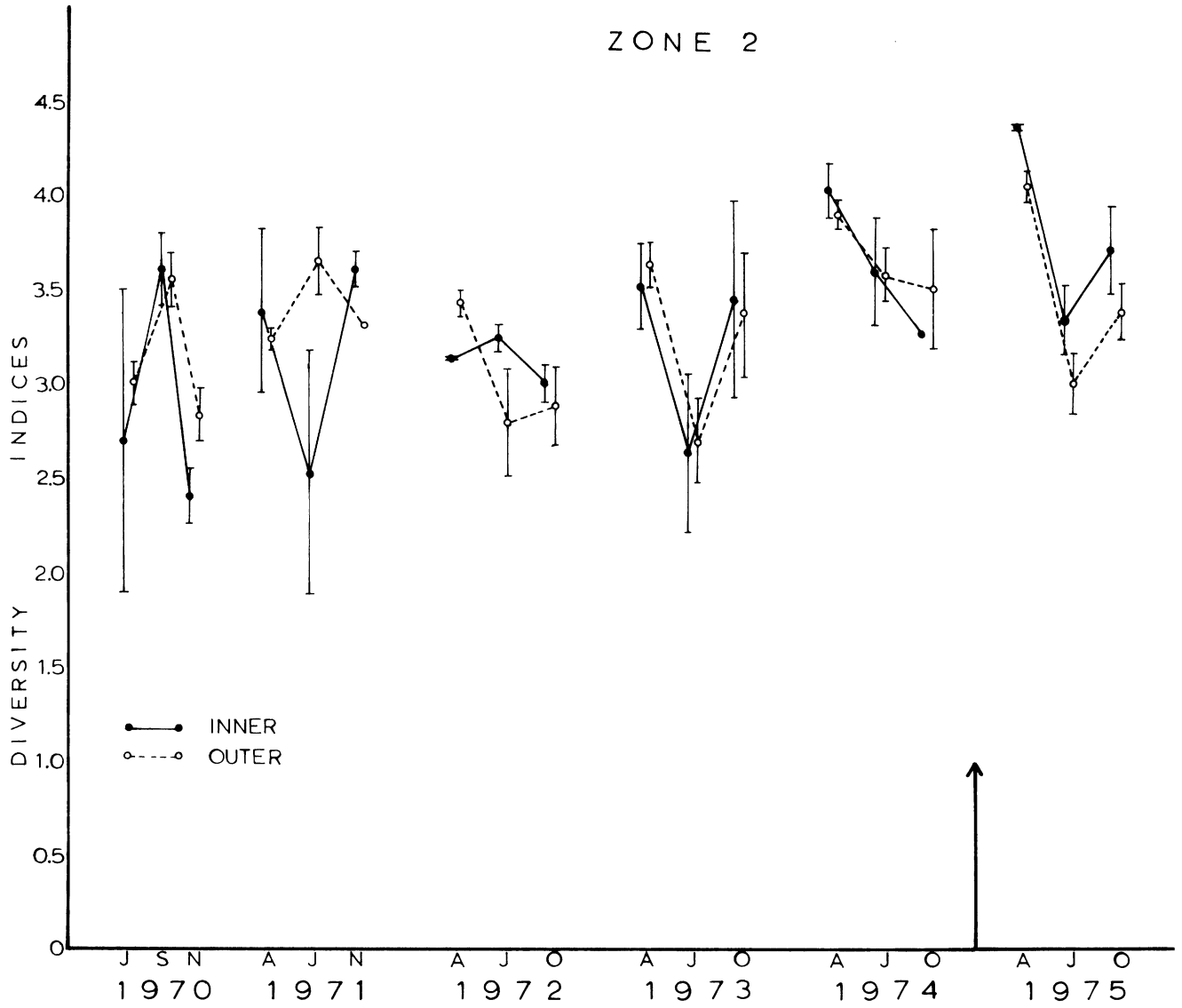
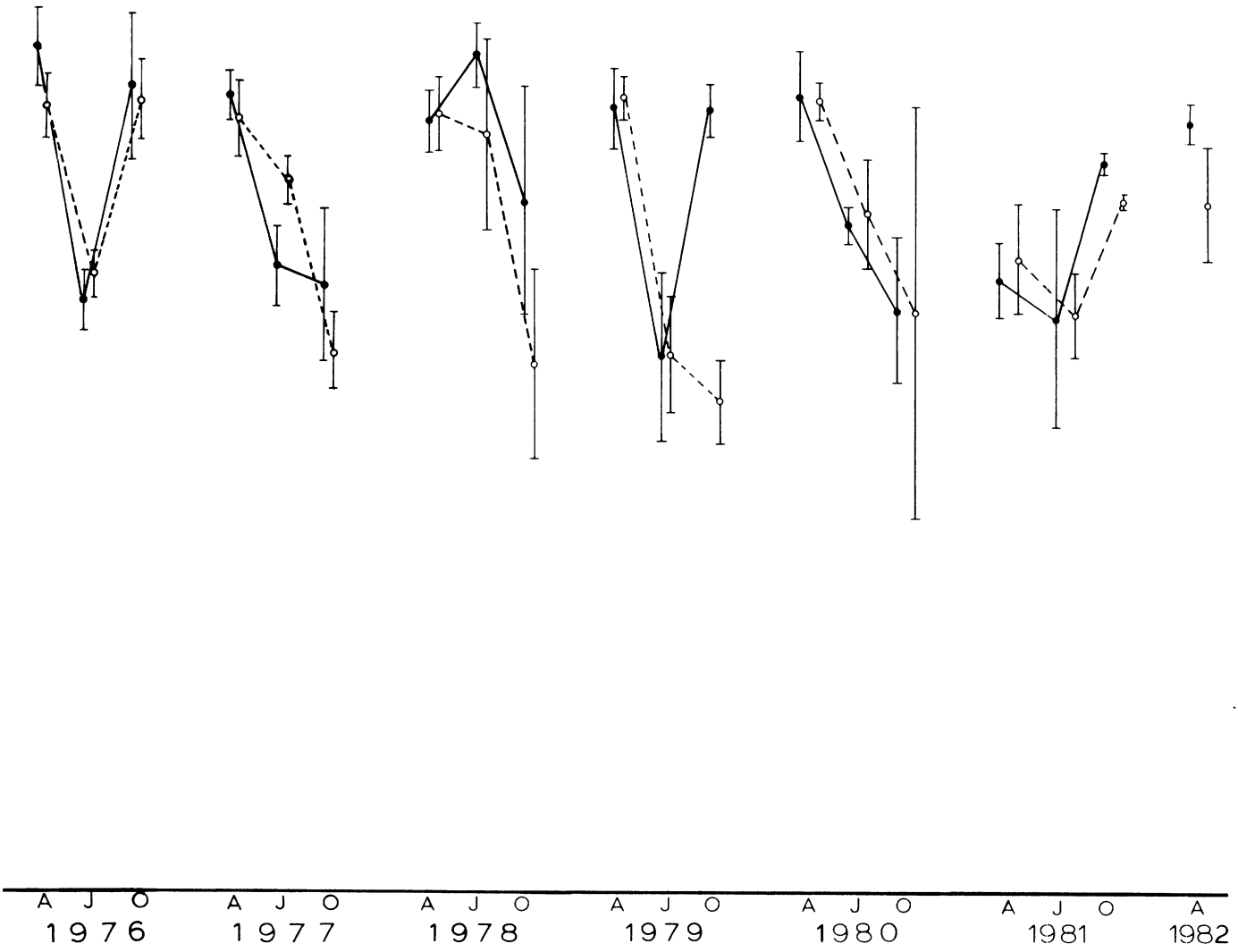


FIG. 2C. Mean diversity indices in zone 2 by spring, summer, and fall seasons and inner and outer station groups in 1970 through 1982. The vertical bars show the standard errors. See Table 4 for numbers of observations.


A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

In Figure 2 the annual curves of mean diversity indices generally show substantial degrees of parallelism between inner (treatment) and outer (control) station groups. Parallelism between the curve for inner and outer stations indicates that changes in diversity from season to season have been the same in both sets of stations. Parallelism of the curves in the operational years 1975 through 1981 has been as good as or better than in the preoperational years.

The placement, on the graphs, of annual curves for inner and outer station groups indicates that in zones 0 and 1 the diversities for 1981 were lower than in the preceding operational years; in zone 2 the diversities were not noticeably different from those of preceding years. Spring values in 1982 had returned to 1980 levels. In all zones diversities were higher than in preoperational years prior to 1974.

Inner-Outer Graphical Comparisons: Phytoplankton Redundancies

Redundancy values are derived from the diversity index of Wilhm and Dorris (1968):

$$\bar{d} = - \sum_{i=1}^{S} (n_i/n) \log_2 (n_i/n)$$

where S is the number of species, n is the total number of phytoplankton in cells/mL, n_i is the number of phytoplankton of the i^{th} species. Diversity as presented here is not the true diversity since not all forms encountered can be identified to the species level. Therefore, this diversity must be viewed with caution. However, since these diversities do mean something about community structure they will be used to illustrate changes occurring within the phytoplankton population from year to year and for the derivation of redundancies.

Redundancy is a measure of the dominance of one or a few species within a given population. As presented by Wilhm and Dorris (1968) it is:

$$r = \frac{\bar{d}_{max} - \bar{d}}{\bar{d}_{max} - \bar{d}_{min}}$$

where $\bar{d}$ is the observed diversity as calculated above, $\bar{d}_{max}$ is the maximum diversity for a particular community, and $\bar{d}_{min}$ is the minimum possible diversity for a particular community. $\bar{d}_{max}$ is calculated using the following equation:

$$\bar{d}_{max} = (1/n)(\log_2 n! - s \log_2 [n/S]!)$$

and $\bar{d}_{min}$ is calculated using the equation:

$$\bar{d}_{min} = (1/n)(\log_2 n! - s \log_2 [n-(S-1)]!)$$

The values of r range between 0 and 1. An r equal to 0 implies that the species encountered in a community each have the same number of cells. An r equal to 1 implies that one species dominates the community of phytoplankton. The values for years 1970 - 1976 have been reported by Ayers (1978); those for 1977 were reported by Ayers and Wiley (1979); and 1978 and 1979 are reported by Ayers and Feldt (1982). Table 5 gives the means, standard errors, and numbers of observations of redundancies in Cook Plant seasonal surveys during 1980, 1981, and April 1982 stratified by seasons, depth zones, and inner and outer station groups. The means and standard errors are plotted on a time axis in Figure 3.

After slowly diminishing values in the period 1973 through 1978, redundancies rose to preoperational levels for the years 1979 through 1981. Spring re-

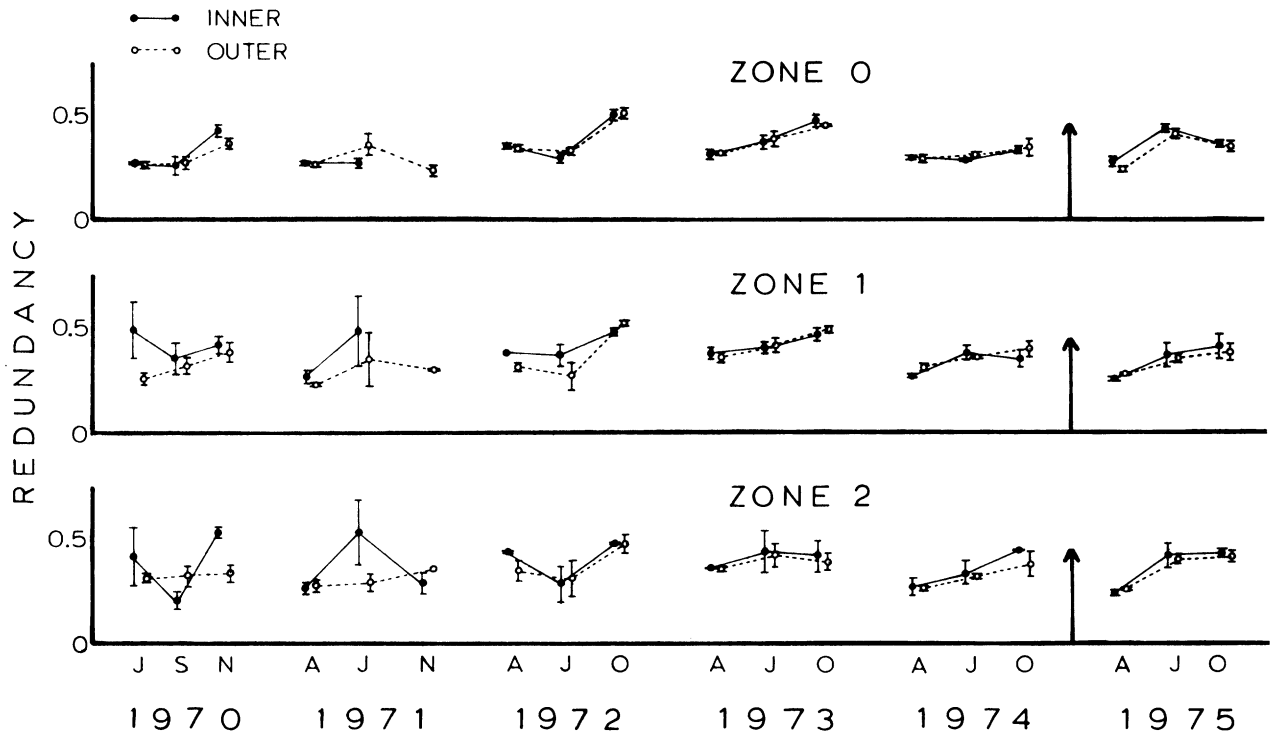


FIG. 3. Mean redundancies of phytoplankton collections from three depth zones in the Cook Plant area, by spring, summer, and fall seasons and inner and outer station groups in 1970 through 1982. The vertical bars show the standard errors. See Table 5 for numbers of observations.

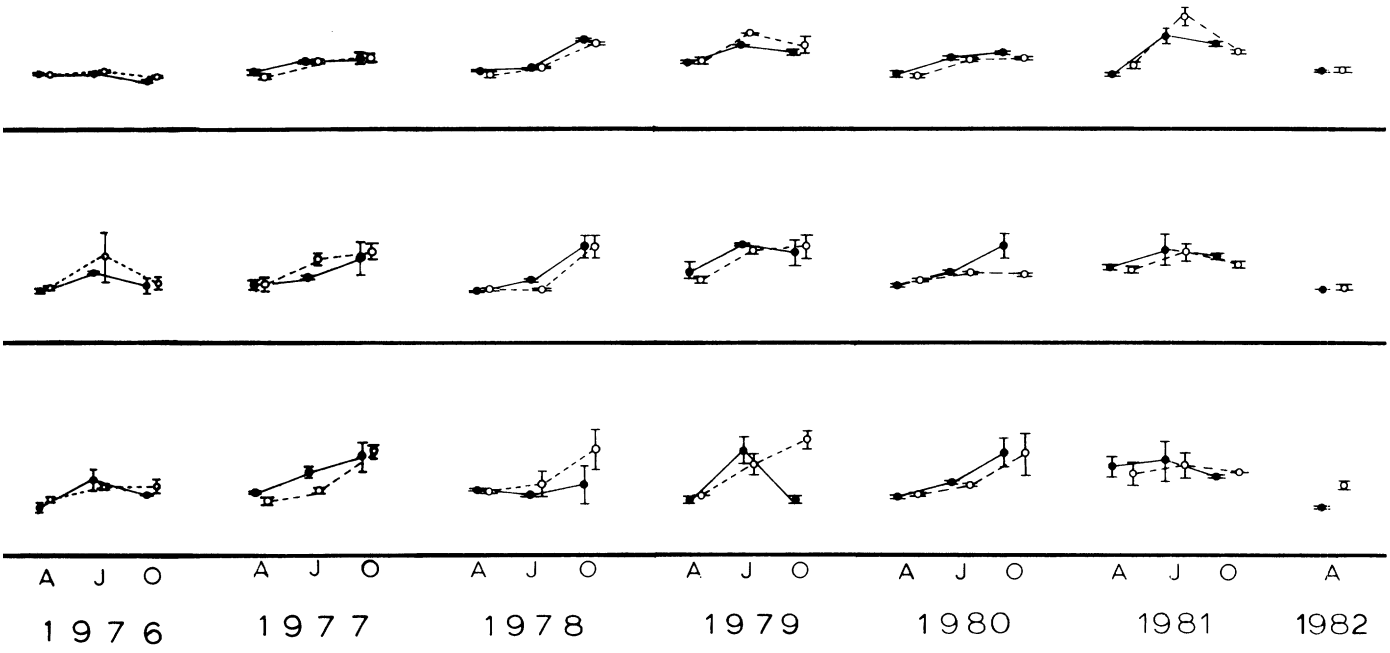

A J O
A J O
A J O
A J O
A J O
A J O
A
1976
1977
1978
1979
1980
1981
1982

TABLE 5. Means, standard errors, and numbers of observations of phytoplankton redundancies by seasons, depth zones, and inner and outer station groups in Cook Plant major surveys during operational 1980, 1981, and April 1982.

	1980			1981			1982
	10 April	8 July	15 October	10 April	8 July	14 October	15 April
Zone 0 Inner							
Mean	0.262	0.317	0.351	0.235	0.416	0.374	0.273
S. E.	0.011	0.016	0.025	0.008	0.030	0.011	0.012
N	12	12	12	12	12	12	12
Outer							
Mean	0.249	0.324	0.334	0.274	0.514	0.343	0.261
S. E.	0.010	0.021	0.025	0.019	0.041	0.021	0.015
N	10	10	10	10	10	10	10
Zone 1 Inner							
Mean	0.259	0.333	0.450	0.340	0.420	0.396	0.224
S. E.	0.025	0.028	0.069	0.009	0.072	0.023	0.019
N	3	3	3	3	3	3	3
Outer							
Mean	0.286	0.328	0.312	0.329	0.414	0.360	0.265
S. E.	0.014	0.031	0.015	0.019	0.039	0.016	0.022
N	4	4	4	4	4	4	4
Zone 2 Inner							
Mean	0.268	0.342	0.486	0.401	0.437	0.351	0.228
S. E.	0.023	0.004	0.062	0.039	0.087	0.004	0.012
N	2	2	2	2	2	2	2
Outer							
Mean	0.285	0.331	0.469	0.383	0.409	0.376	0.338
S. E.	0.013	0.042	0.099	0.048	0.043	0.012	0.058
N	4	4	4	4	4	4	4

dundancies in 1982 were, in all three depth zones, the lowest yet recorded.

Perhaps more important is that after 1972 there has been much better parallelism between the annual curves of redundancies at inner and outer station groups; that is, changes in mean redundancies of collections from the two station groups have been much more alike than was the case in earlier preoperational years. As it began in the preoperational years and has continued into the operational years, the tendency for improved parallelism is attributed to some cause in the lake itself.

There is nothing in this analysis of phytoplankton redundancies to indicate that the operation of Cook Plant has exerted any adverse impact on the local phytoplankton community.

Inner-Outer Graphical Comparisons: Phytoplankton Abundances By Algal Categories

This section applies the inner-outer graphical analysis method to the abundances (in cells per mL) of ten major categories of phytoplankton and extends previously reported tabulations, figures, and discussions to include the seasonal surveys of 1980, 1981, and April 1982. Earlier years were reported by Ayers, Southwick, and Robinson (1977); 1977 was reported by Ayers and Wiley (1979); 1978 and 1979 were given by Ayers and Feldt (1982).

The phytoplankton abundances used are those of total algae and of the nine major algal groups: coccoid blue-greens, filamentous blue-greens, coccoid greens, filamentous greens, flagellates, centric diatoms, pennate diatoms, desmids, and other algae. The use of major algal groups bypasses difficulties stemming from inability always to identify to species, and is justifiable on the basis that members of each individual group have more or less similar functions in the ecosystem.

Table 6 presents, for the seasonal surveys of 1980-April 1982, means, standard errors, and numbers of observations of abundances of total algae and the nine major groups of planktonic algae in the three depth zones and the inner and outer station groups. These are graphed with the preceding years in Figure 4.

Filamentous green algae (Fig. 4A), which in April 1976 had somewhat increased in abundance in both station groups and in all three depth zones, returned to preoperational levels in July of that year and have remained there ever since.

Desmids (Fig. 4B) have shown almost no variation in abundance over the entire 12 years of the study.

Filamentous blue-green algae (Fig. 4C) have been more abundant in all depth zones and both sets of stations in the 7 operational years. On the whole, these algae show a slow increase from 1970 through 1981, although 1980 was a year with lower abundances and 1982 exhibited typical low spring numbers. The increased abundances were generally in all three depth zones and in both station groups; they are consequently considered to be effects of lake eutrophication, rather than effects of plant operation.

Coccoid green algae (Fig. 4D) have been present in all depth zones and both station groups in variable abundances of about 500 cells per mL in each survey of the study area. An unusually high mean abundance at zone 0 outer stations in April 1981 was due to a single-sample collection of 9,550 cells/mL at station SDC-2-0; with this sample omitted, the mean became 56.01 $\pm$ 15.53 cells/mL, otherwise their abundances in 1981 and spring 1982 were comparable to those of the preceding years.

Table 6. Means, standard errors, and numbers of observations of phytoplankton abundances by seasons, depth zones, and inner and outer station groups in Cook Plant major surveys during 1980, 1981, and April 1982. Units are cells per mL. B-G = blue-greens, Filam. = filamentous.

Zone	Inner Outer	Coccoid B-G	Filam. B-G	Coccoid greens	Filam. greens	Flagel-lates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae
10 APRIL 1980											
0	Inner										
	Mean	123.25	5.94	180.17	0.55	743.78	914.98	936.81	0.83	67.28	2974.26
	S. E.	69.95	1.60	72.07	0.55	125.59	153.17	164.75	0.59	26.10	370.85
	N	12	12	12	12	12	12	12	12	12	12
	Outer										
	Mean	2.65	11.26	132.32	1.99	1308.88	1088.35	999.15	0.99	81.57	3627.19
	S. E.	2.65	4.02	63.31	1.99	213.51	135.45	135.85	0.71	29.10	375.58
	N	10	10	10	10	10	10	10	10	10	10
1	Inner										
	Mean	42.00	2.77	21.57	0	764.37	907.80	581.97	1.10	4.40	2403.67
	S. E.	42.00	1.47	9.25	0	235.76	107.61	95.24	1.10	2.91	374.45
	N	3	3	3	3	3	3	3	3	3	3
	Outer										
	Mean	9.10	5.80	7.45	0	1067.38	799.58	572.00	3.73	43.95	2509.05
	S. E.	6.25	4.77	6.40	0	83.30	187.48	102.06	2.17	12.37	211.48
	N	4	4	4	4	4	4	4	4	4	4
2	Inner										
	Mean	165.80	31.50	37.35	9.10	651.60	438.55	317.55	0	114.40	1765.85
	S. E.	33.20	29.80	26.41	9.10	8.30	0.85	32.35	0	89.50	74.65
	N	2	2	2	2	2	2	2	2	2	2
	Outer										
	Mean	170.78	3.73	22.78	0	872.58	630.08	368.53	3.73	17.40	2089.58
	S. E.	91.12	1.70	8.41	0	175.91	36.79	82.62	3.73	5.70	353.04
	N	4	4	4	4	4	4	4	4	4	4
9 JULY 1980											
0	Inner										
	Mean	371.61	99.70	97.40	0	447.84	246.43	2018.00	0.41	189.37	3470.82
	S. E.	83.22	36.06	17.80	0	50.21	73.37	543.56	0.34	45.97	652.16
	N	12	12	12	12	12	12	12	12	12	12
	Outer										
	Mean	293.63	200.79	131.64	0.17	600.55	150.22	1290.14	1.49	137.81	2806.43
	S. E.	112.21	86.57	31.93	0.17	112.29	42.24	356.38	0.66	44.44	629.01
	N	10	10	10	10	10	10	10	10	10	10
1	Inner										
	Mean	179.33	97.83	86.50	0.27	618.47	53.63	395.17	0.83	127.67	1559.70
	S. E.	72.57	33.78	9.84	0.27	96.74	3.18	67.48	0.49	33.46	209.31
	N	3	3	3	3	3	3	3	3	3	3
	Outer										
	Mean	165.48	102.93	128.18	0	348.20	56.38	403.95	2.10	47.65	1254.88
	S. E.	53.27	49.01	38.73	0	42.67	11.46	108.02	1.05	13.01	125.87
	N	4	4	4	4	4	4	4	4	4	4
2	Inner										
	Mean	247.70	87.05	107.15	0	459.25	42.10	223.20	0.40	54.70	1221.55
	S. E.	85.60	22.35	47.45	0	35.25	19.70	28.00	0.00	2.50	240.85
	N	2	2	2	2	2	2	2	2	2	2
	Outer										
	Mean	323.65	110.15	104.25	0.83	356.48	43.13	277.10	1.13	44.78	1261.48
	S. E.	142.32	34.71	27.52	0.83	44.34	8.10	81.09	0.47	9.11	193.00
	N	4	4	4	4	4	4	4	4	4	4

Table 6 continued.

Zone	Inner Outer	Coccoid B-G	Filam. B-G	Coccoid greens	Filam. greens	Flagel-lates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae
15 OCTOBER 1980											
0	Inner										
	Mean	2281.91	32.32	193.84	8.56	843.82	966.79	649.96	0.83	243.18	5221.25
	S. E.	327.98	17.90	24.85	2.47	134.57	159.30	98.51	0.43	39.96	516.79
	N	12	12	12	12	12	12	12	12	12	12
	Outer										
	Mean	2097.95	41.13	334.11	18.25	867.35	967.32	665.38	0.99	280.20	5266.33
	S. E.	336.58	15.82	74.02	8.97	120.38	133.32	105.22	0.71	71.44	530.01
	N	10	10	10	10	10	10	10	10	10	10
1	Inner										
	Mean	7136.33	75.17	205.63	1.10	1013.63	889.83	510.70	0	168.00	6997.33
	S. E.	2556.77	39.91	105.40	1.10	320.87	47.05	204.22	0	73.55	3315.21
	N	3	3	3	3	3	3	3	3	3	3
	Outer										
	Mean	1212.45	82.90	197.73	41.45	759.80	555.48	452.23	0.43	198.13	3500.58
	S. E.	448.87	68.61	43.79	38.22	66.12	234.72	224.95	0.43	25.03	911.75
	N	4	4	4	4	4	4	4	4	4	4
2	Inner										
	Mean	2966.25	82.90	116.10	0	572.05	1253.50	643.35	0	179.05	5813.20
	S. E.	654.95	69.60	63.00	0	81.25	165.80	139.25	0	92.85	43.10
	N	2	2	2	2	2	2	2	2	2	2
	Outer										
	Mean	5096.90	31.50	135.98	2.48	803.33	570.43	423.63	0.83	115.23	7180.18
	S. E.	2074.85	22.11	49.62	1.58	157.18	141.95	107.36	0.83	11.53	1959.77
	N	4	4	4	4	4	4	4	4	4	4
10 APRIL 1981											
0	Inner										
	Mean	389.09	17.69	88.98	0.55	1632.91	702.74	1603.33	0.83	232.13	4668.28
	S. E.	112.01	3.80	19.87	0.55	121.78	74.43	201.58	0.59	33.29	352.68
	N	12	12	12	12	12	12	12	12	12	12
	Outer										
	Mean	427.13	28.28	1005.45	0.66	2159.63	559.43	1267.42	1.98	1380.65	6830.73
	S. E.	189.31	8.14	949.54	0.66	623.81	47.86	5.14	1.12	1195.76	2785.42
	N	10	10	10	10	10	10	10	10	10	10
1	Inner										
	Mean	445.47	11.03	27.63	0	1620.47	333.83	603.53	0	123.80	3165.83
	S. E.	322.06	4.83	19.55	0	205.54	63.40	144.35	0	10.55	570.72
	N	3	3	3	3	3	3	3	3	3	3
	Outer										
	Mean	248.73	9.53	28.63	0.43	1427.60	313.38	518.55	1.65	98.65	2647.13
	S. E.	188.33	3.98	18.37	0.43	206.77	49.79	110.70	1.65	13.64	474.48
	N	4	4	4	4	4	4	4	4	4	4
2	Inner										
	Mean	0	26.50	41.45	9.15	1219.50	185.70	408.70	1.65	73.80	1966.45
	S. E.	0	19.90	34.85	4.15	7.50	6.60	72.10	1.65	14.10	132.65
	N	2	2	2	2	2	2	2	2	2	2
	Outer										
	Mean	4.15	4.55	24.88	0	1464.90	245.80	248.73	0.43	88.30	2081.70
	S. E.	4.15	0.79	17.48	0	70.51	36.51	68.51	0.43	41.17	208.71
	N	4	4	4	4	4	4	4	4	4	4

Table 6 continued.

Zone	Inner Outer	Coccoid B-G	Filam. B-G	Coccoid greens	Filam. greens	Flagel-lates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae
8 JULY 1981											
0	Inner										
	Mean	42.83	977.02	156.07	1.93	940.68	76.13	593.87	0.14	32.47	2821.13
	S. E.	42.83	350.39	40.59	1.19	103.07	24.63	185.10	0.14	6.97	506.90
	N	12	12	12	12	12	12	12	12	12	12
	Outer										
	Mean	155.86	1510.83	112.59	3.15	1484.79	57.36	379.69	0	13.09	3717.37
	S. E.	138.07	466.55	58.69	1.98	324.35	17.14	130.40	0	5.27	888.37
	N	10	10	10	10	10	10	10	10	10	10
1	Inner										
	Mean	7.20	434.43	112.47	5.00	1094.33	42.27	247.03	0.57	27.10	1970.33
	S. E.	7.20	205.27	97.98	4.18	349.28	26.69	133.15	0.57	13.57	571.84
	N	3	3	3	3	3	3	3	3	3	3
	Outer										
	Mean	26.52	456.18	77.53	4.15	1176.20	115.23	202.90	1.45	19.88	2080.05
	S. E.	24.38	194.70	16.85	1.44	213.57	15.68	47.88	0.71	5.79	289.10
	N	4	4	4	4	4	4	4	4	4	4
2	Inner										
	Mean	0	803.30	15.75	7.05	986.15	88.70	211.80	0	17.85	2130.65
	S. E.	0	682.30	15.75	5.35	57.65	2.50	76.70	0	12.85	669.85
	N	2	2	2	2	2	2	2	2	2	2
	Outer										
	Mean	0	1232.78	292.23	3.73	1637.38	179.08	254.50	2.50	64.68	3666.80
	S. E.	0	865.01	181.57	2.17	528.25	76.93	88.60	1.45	39.02	1693.37
	N	4	4	4	4	4	4	4	4	4	4
14 OCTOBER 1981											
0	Inner										
	Mean	2062.34	35.07	197.03	3.45	2125.63	824.20	613.63	2.35	174.68	6020.98
	S. E.	355.84	19.20	44.74	1.16	163.95	102.26	64.45	1.36	19.32	548.55
	N	12	12	12	12	12	12	12	12	12	12
	Outer										
	Mean	1394.76	133.95	250.70	1.82	1675.47	742.15	487.81	1.16	381.39	4773.73
	S. E.	419.44	125.22	52.23	0.71	154.48	87.34	73.98	0.70	189.34	613.83
	N	10	10	10	10	10	10	10	10	10	10
1	Inner										
	Mean	1460.29	72.93	259.80	0.57	1805.60	767.13	436.97	1.10	138.13	5017.30
	S. E.	669.39	71.29	124.85	0.57	83.06	205.68	172.30	1.10	12.75	987.61
	N	3	3	3	3	3	3	3	3	3	3
	Outer										
	Mean	1311.95	12.43	142.60	0.83	1602.13	676.88	361.85	0	130.58	4239.25
	S. E.	376.35	12.43	50.90	0.83	264.54	130.81	100.92	0	62.62	887.01
	N	4	4	4	4	4	4	4	4	4	4
2	Inner										
	Mean	958.35	24.85	289.35	6.65	2038.60	542.20	768.50	1.65	199.80	4829.95
	S. E.	484.5	18.25	35.65	6.65	166.60	97.80	422.00	1.65	95.30	1291.65
	N	2	2	2	2	2	2	2	2	2	2
	Outer										
	Mean	1402.30	1.25	129.75	0	1399.83	309.65	189.83	0	89.95	3522.55
	S. E.	575.17	0.79	45.46	0	237.98	57.33	58.44	0	23.33	940.52
	N	4	4	4	4	4	4	4	4	4	4

Table 6 concluded.

Zone	Inner Outer	Coccoid B-G	Filam. B-G	Coccoid greens	Filam. greens	Flagel-lates	Centric diatoms	Pennate diatoms	Desmids	Other algae	Total algae
15 APRIL 1982											
0	Inner										
	Mean	257.27	13.53	480.98	8.01	2185.20	1950.71	1590.08	0.55	360.36	6846.69
	S. E.	152.14	3.15	371.76	3.90	389.66	232.08	221.93	0.37	81.83	1000.89
	N	12	12	12	12	12	12	12	12	12	12
	Outer										
	Mean	37.81	34.81	251.20	10.09	1533.87	1809.60	1201.92	0.99	301.95	5182.44
	S. E.	25.25	18.88	149.11	5.25	161.97	89.47	98.06	0.71	37.66	329.10
	N	10	10	10	10	10	10	10	10	10	10
1	Inner										
	Mean	0	11.03	21.00	26.53	1372.90	938.47	961.70	0	190.13	3521.73
	S. E.	0	4.83	3.97	23.31	191.37	161.40	75.42	0	50.73	377.29
	N	3	3	3	3	3	3	3	3	3	3
	Outer										
	Mean	0	70.88	129.73	8.30	1307.38	834.40	940.95	0	134.73	3426.65
	S. E.	0	62.66	66.83	8.30	321.53	194.68	229.37	0	57.49	783.85
	N	4	4	4	4	4	4	4	4	4	4
2	Inner										
	Mean	3.30	9.95	39.80	0	1450.80	727.90	708.00	0	77.90	3017.65
	S. E.	3.30	3.35	13.30	0	326.60	253.70	240.40	0	8.30	809.15
	N	2	2	2	2	2	2	2	2	2	2
	Outer										
	Mean	73.38	7.45	21.15	2.48	1271.73	458.03	686.03	0.83	40.20	2561.28
	S. E.	72.28	3.68	11.33	1.58	162.83	81.55	184.17	0.83	8.36	261.79
	N	4	4	4	4	4	4	4	4	4	4

Other algae (Fig. 4E), after increased abundances in July and October of 1978, diminished in 1980 to levels comparable to other operational years. The anomalously high mean at zone 0 outer stations in April 1981 was due to a one-sample collection of 12,137 cells/mL at station SDC-2-0; with that station omitted the mean becomes 185.50 $\pm$ 42.81 cells/mL, otherwise the abundance of these algae in 1981 and spring 1982 was comparable to those of preceding years.

Coccoid blue-greens (Fig. 4F), which had been recorded in small numbers during most of the preoperational surveys, increased notably in October 1974 (due in part to a change in counting method that year) and this pattern has been characteristic in the years since. The increases have taken place in both inner and outer stations, but not in a consistent manner. This continued in 1981.

Flagellates (Fig. 4G), after showing increasing abundances from 1970 through 1978, were somewhat less abundant in 1979 and 1980, but in 1981 they returned to their 1978 levels in zone 0 and attained their greatest recorded abundances in zones 1 and 2. Abundances were high in April 1982.

Pennate diatoms (Fig. 4H) in zone 0 showed summer abundance peaks (believed due to sampling during upwellings) that diminished from 1978 through 1980. In all three depth zones in 1981 the pennates returned to having the more typical summer abundance minima. The general impression from 1978 through 1981 is that pennates in all zones and both station groups have been diminishing in abundance. Spring abundances in 1982 in zone 0 were similar to those of spring 1981; in zones 1 and 2 they were higher than in any spring since 1977.

Centric diatoms (Figs. 4I, 4J, 4K) in 1981 exhibited summer abundance minima in both station groups and in all three depth zones. In depth zone 0 the abundance of centrics has decreased drastically during 1978 through 1981; in zone 1 there has been a modest decrease during 1978-81; in zone 2 their

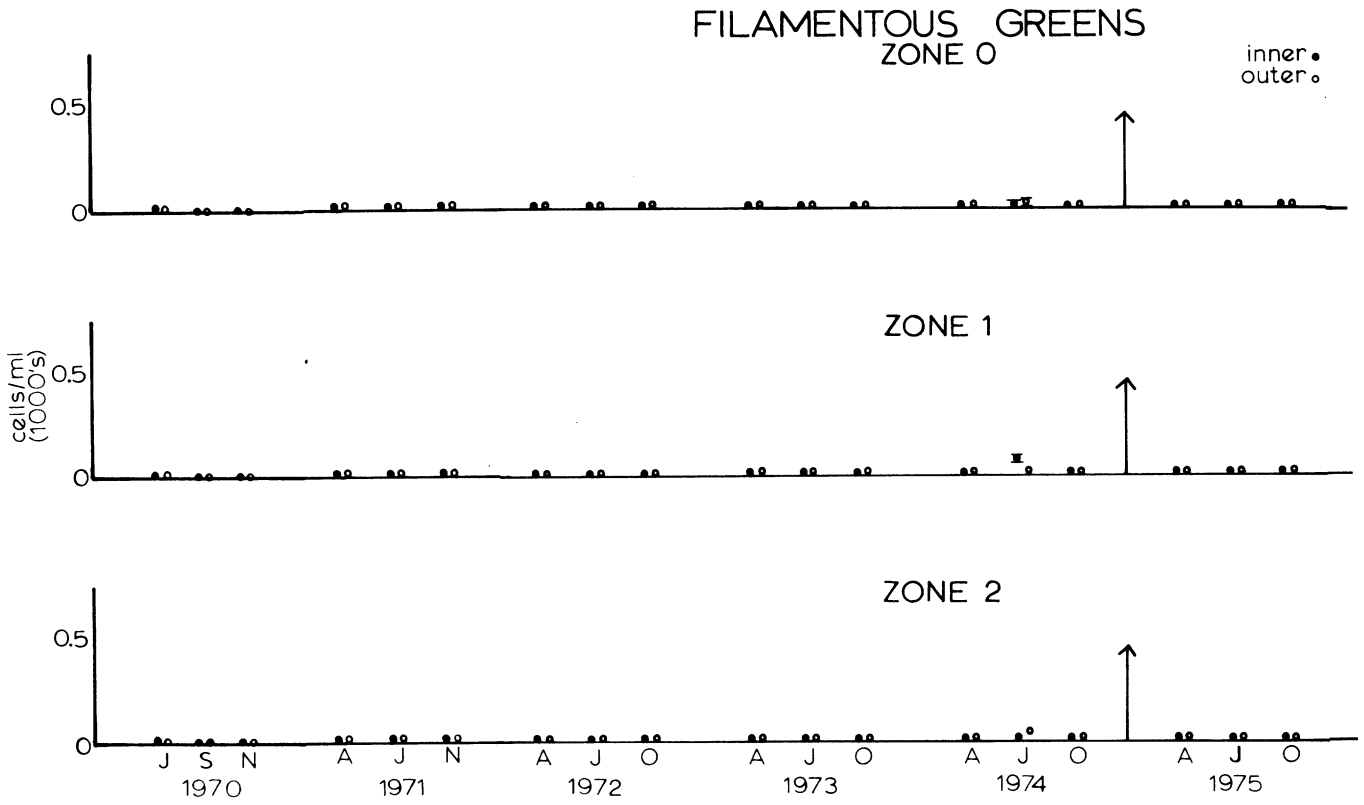
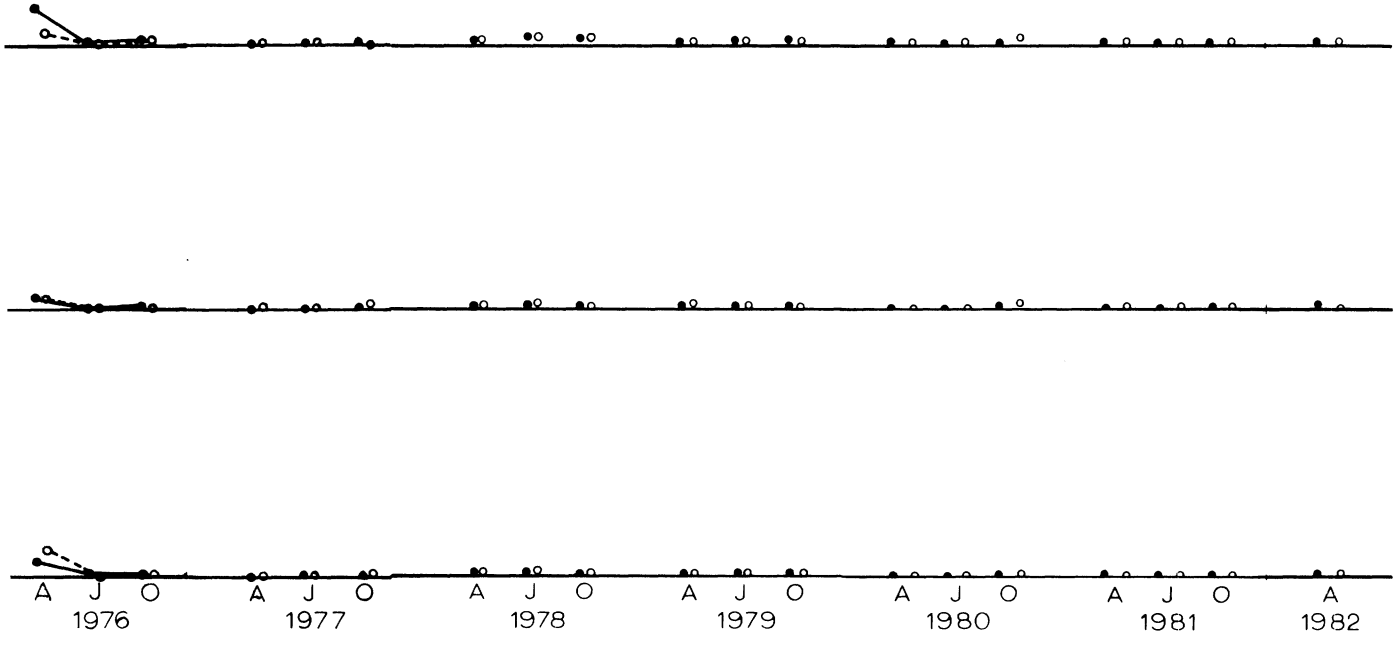


FIG. 4A. Mean abundances of filamentous green algae in zones 0 - 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. Space does not permit the drawing of standard error bars. See Table 6 for standard errors and numbers of observations.


A J O A J O A J O A J O A J O A J O A J O A
1976 1977 1978 1979 1980 1981 1982

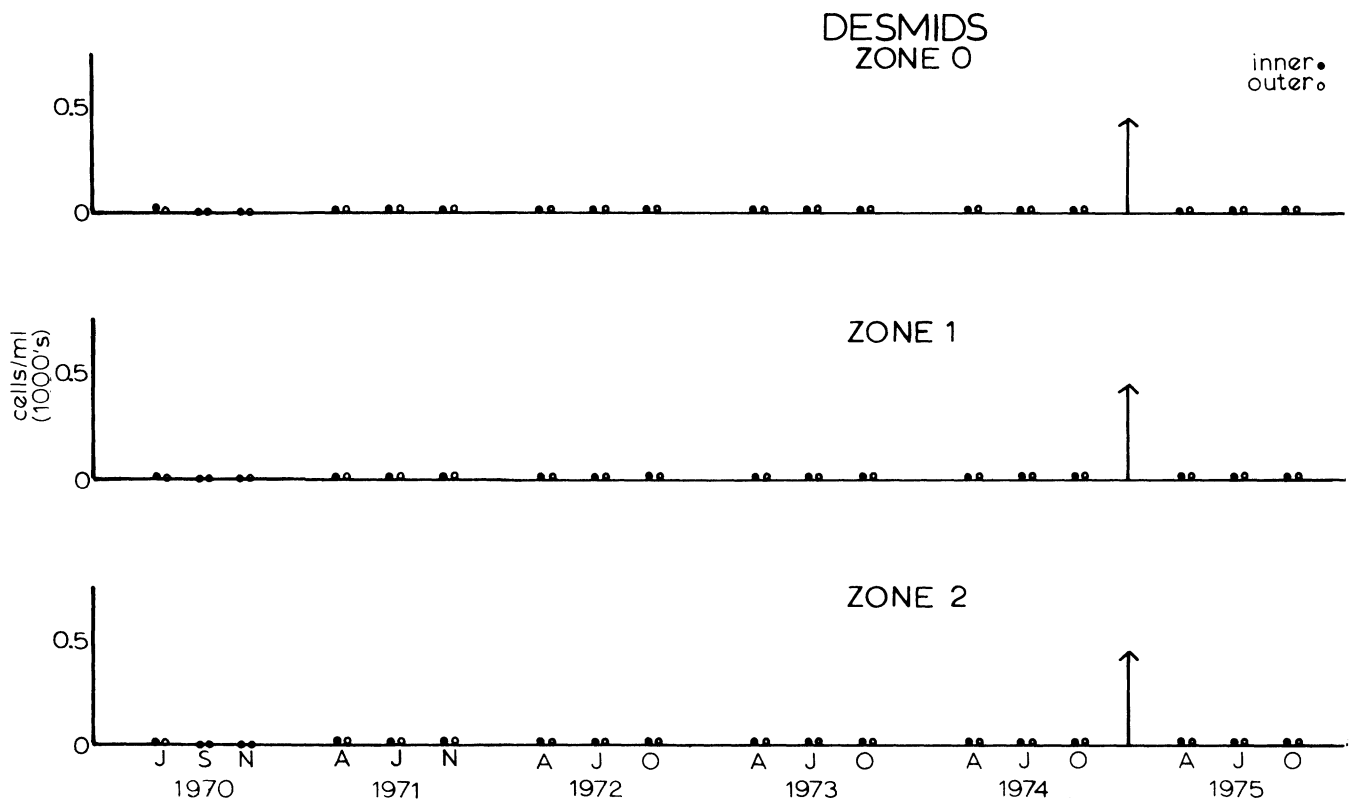
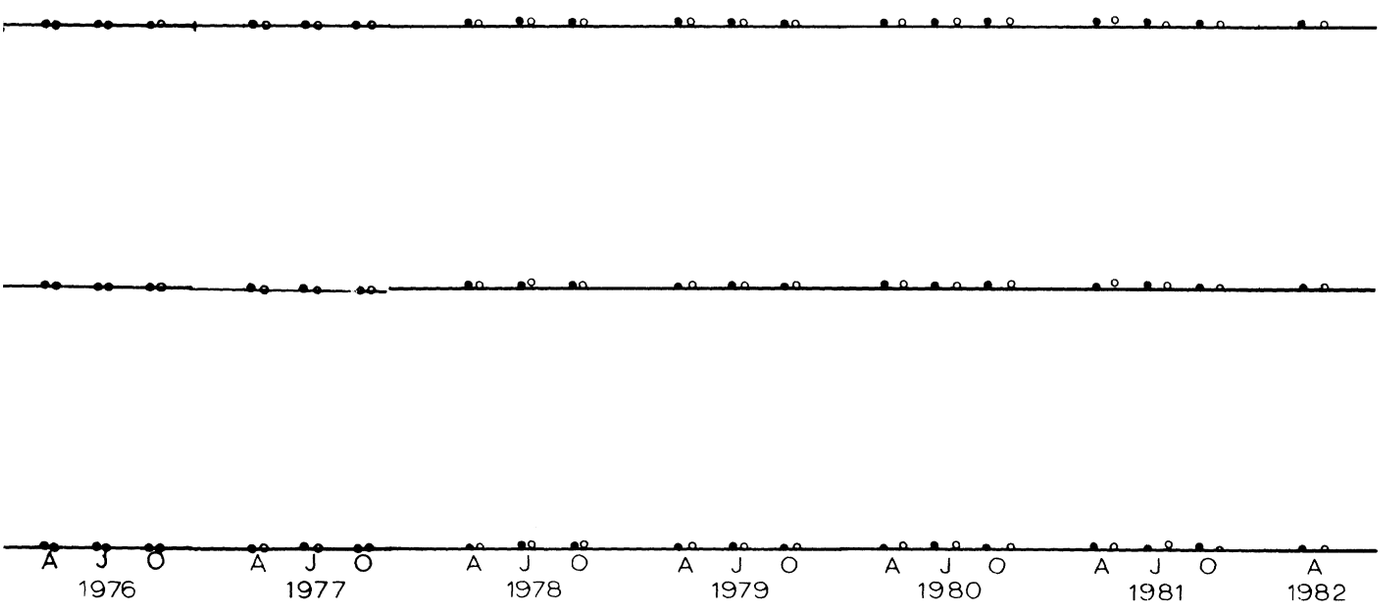


FIG. 4B. Mean abundances of desmids in zones 0 - 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. Space does not permit the drawing of standard error bars. See Table 6 for standard errors and numbers of observations.


A J O A J O A J O A J O A J O A J O A
1976
1977
1978
1979
1980
1981
1982

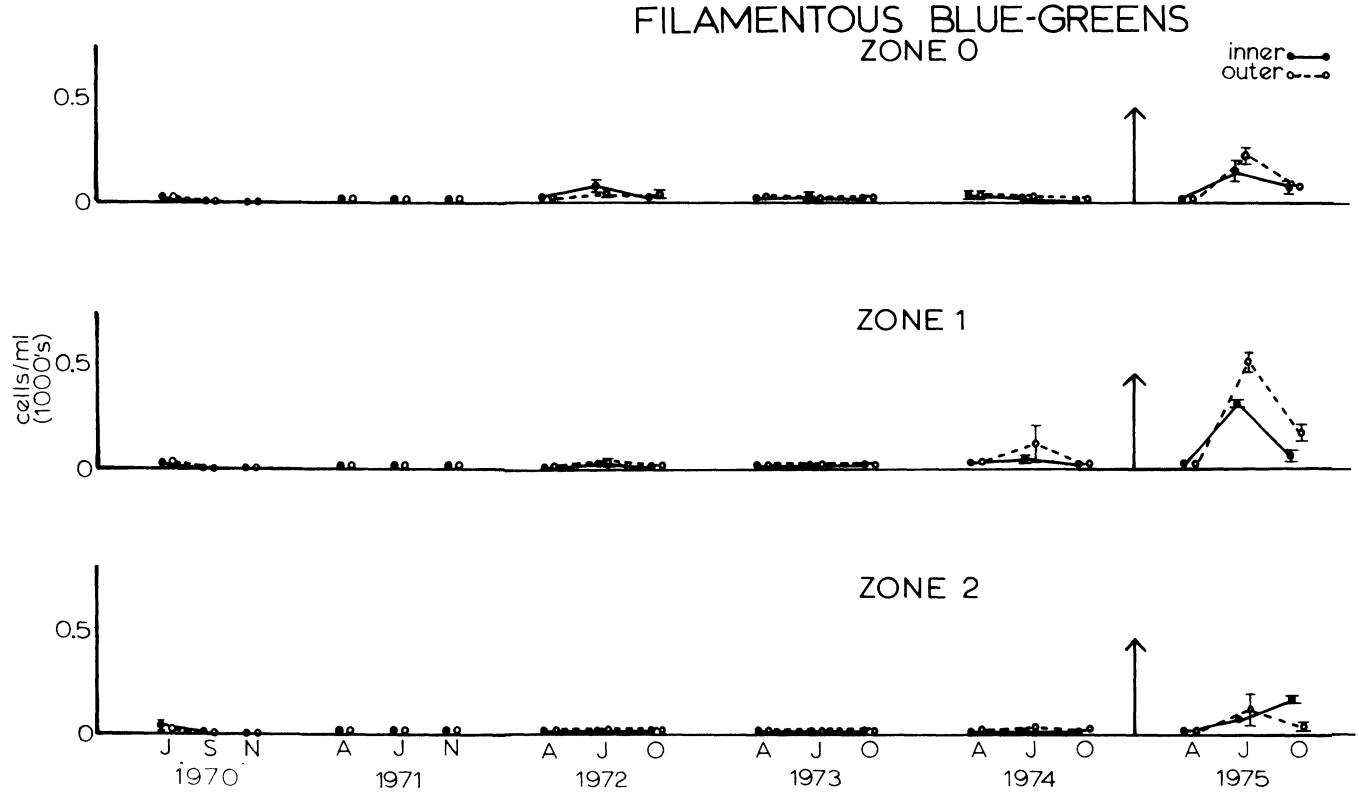
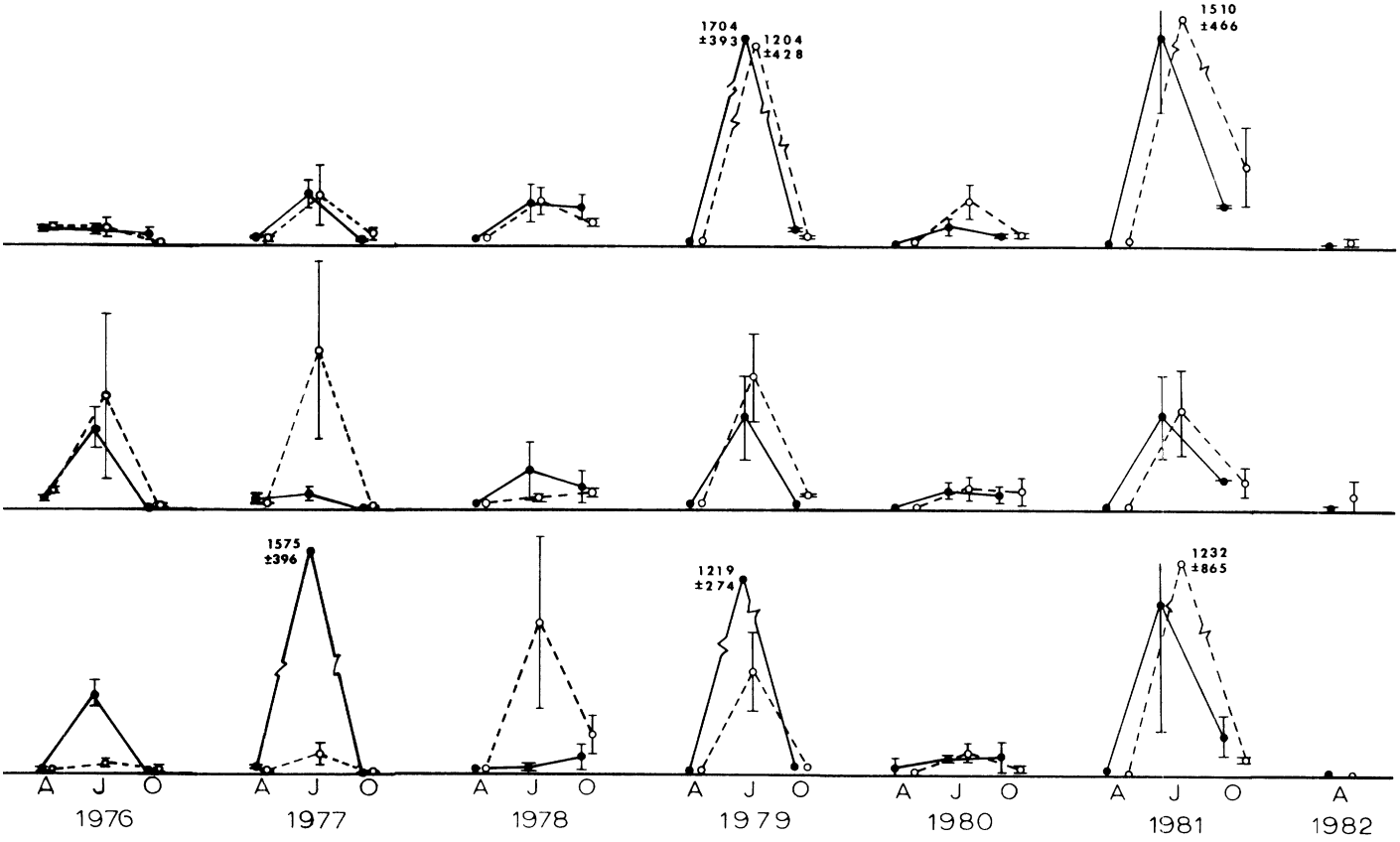


FIG. 4C. Mean abundances of filamentous blue-green algae in zones 0 - 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. Where space permits, vertical bars show the standard errors. See Table 6 for other standard errors and for numbers of observations.


1704
±393
1204
±428
1510
±466
1575
±396
1219
±274
1232
±865
A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

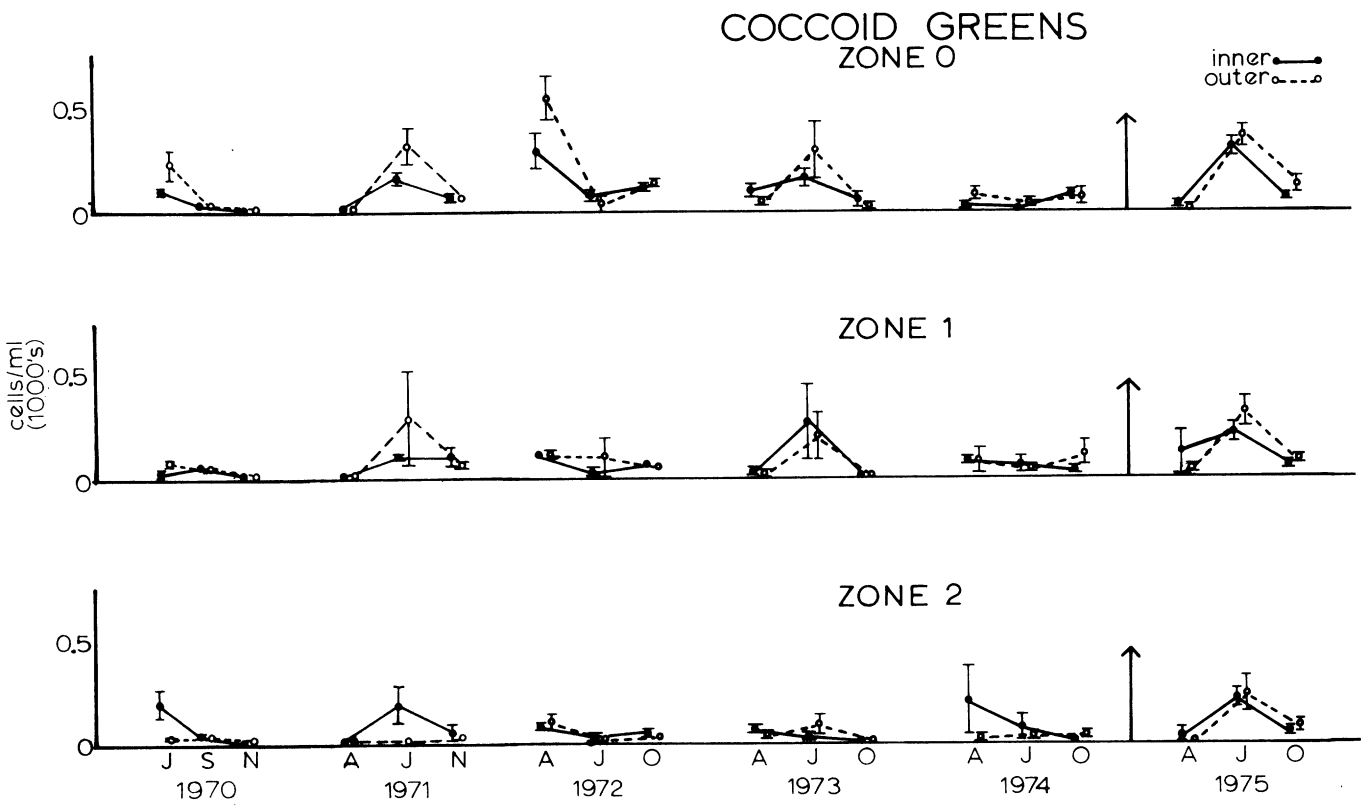
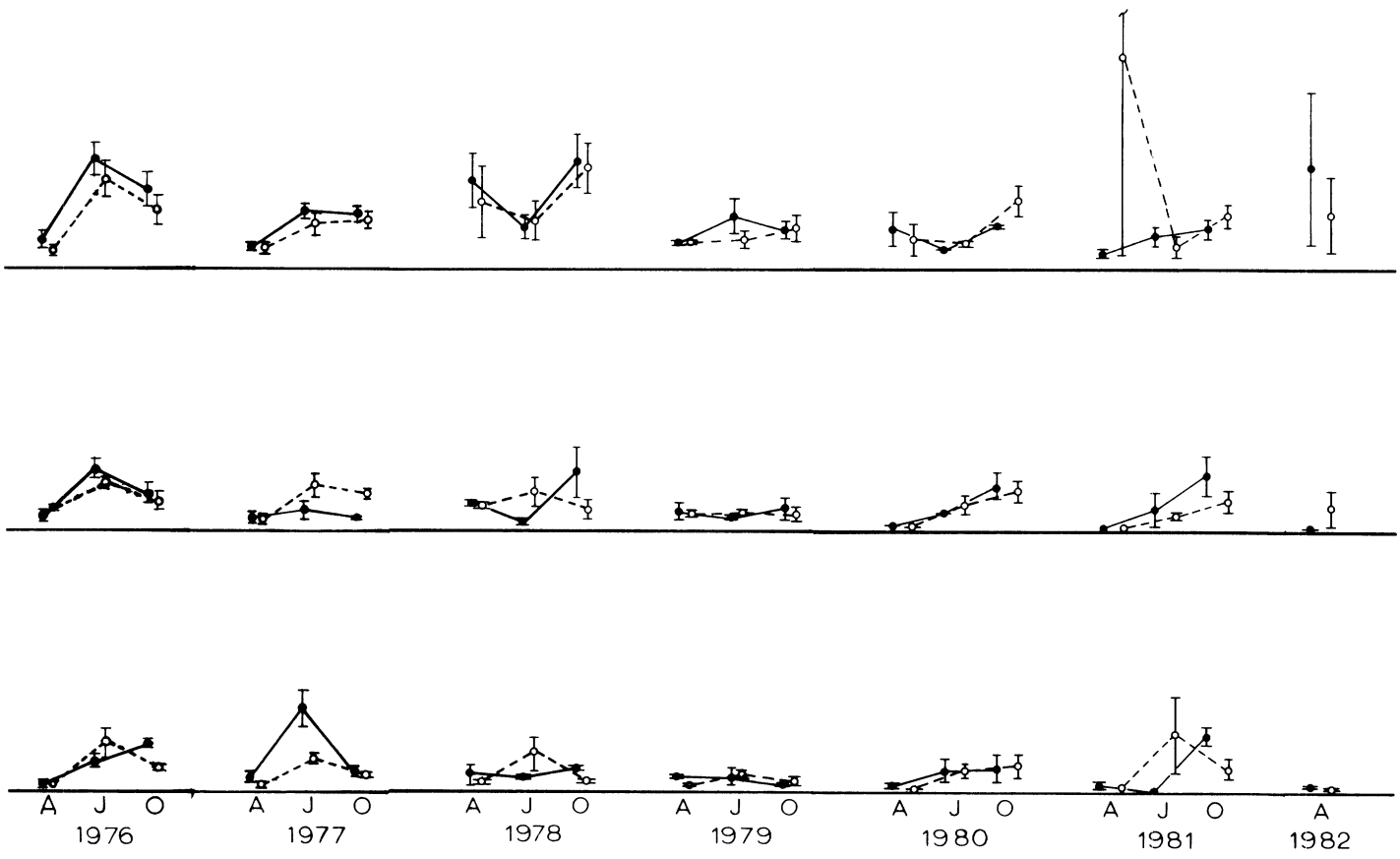


FIG. 4D. Mean abundances of coccoid green algae in zones 0 - 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

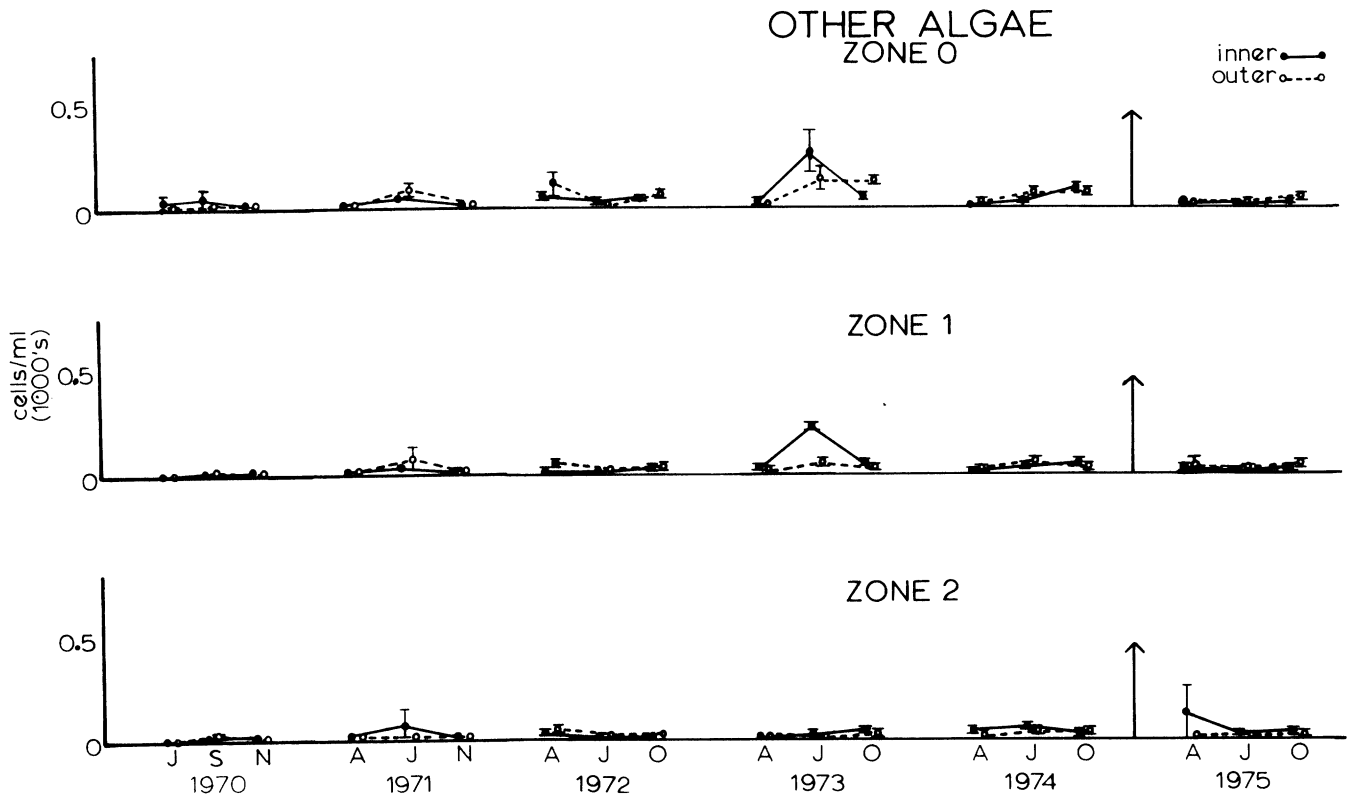
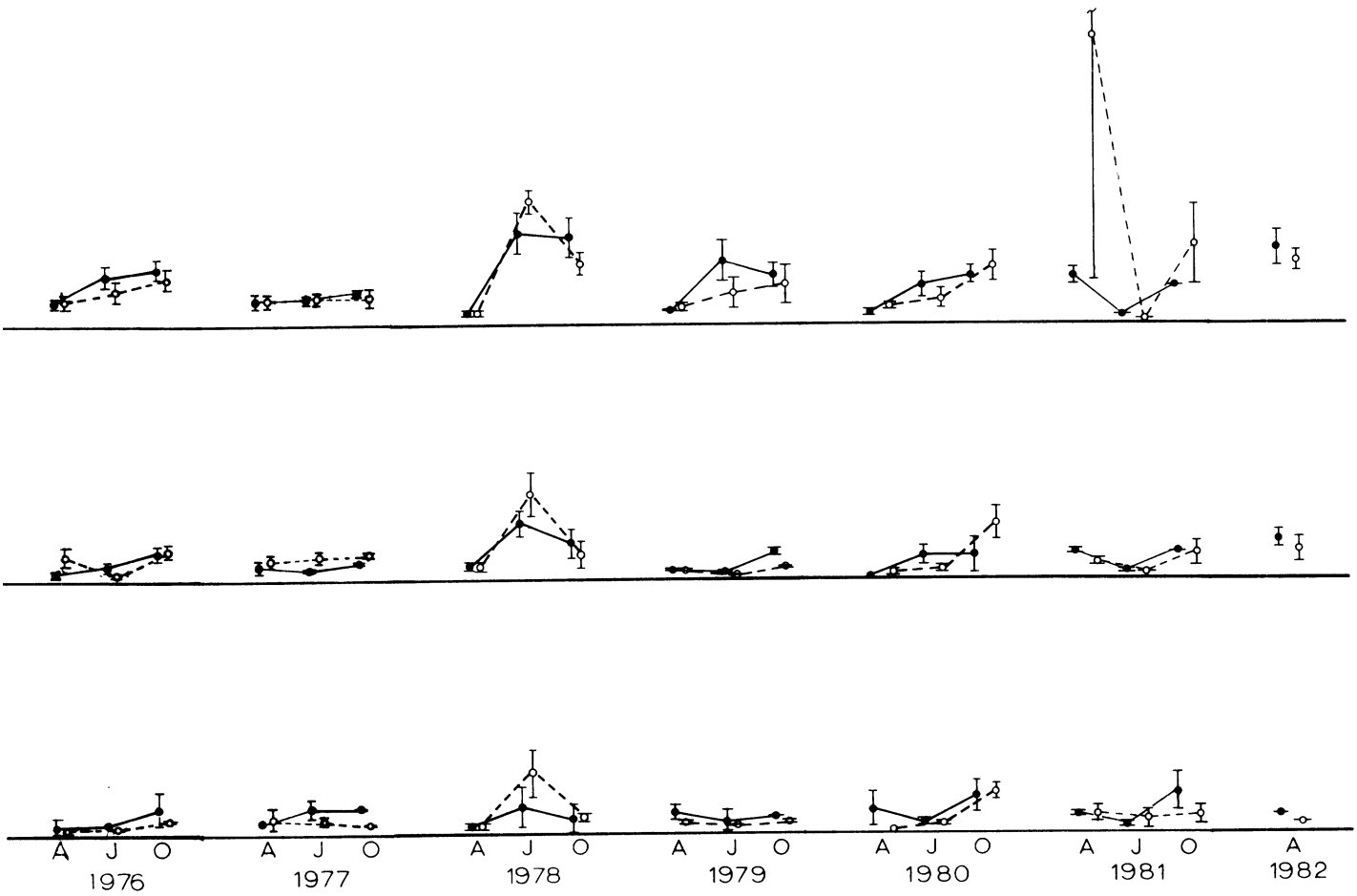


FIG. 4E. Mean abundances of "other algae" in zones 0 - 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

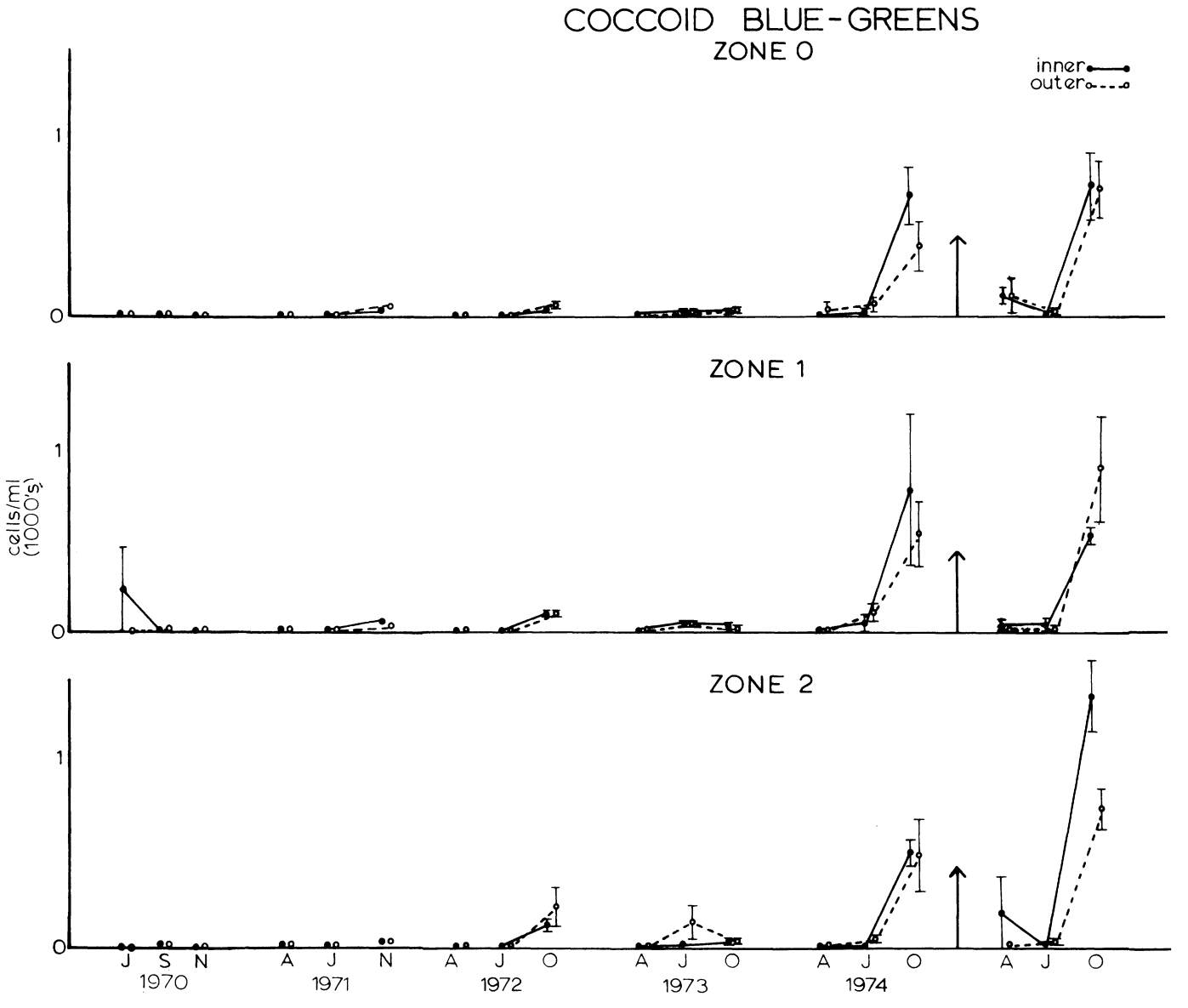
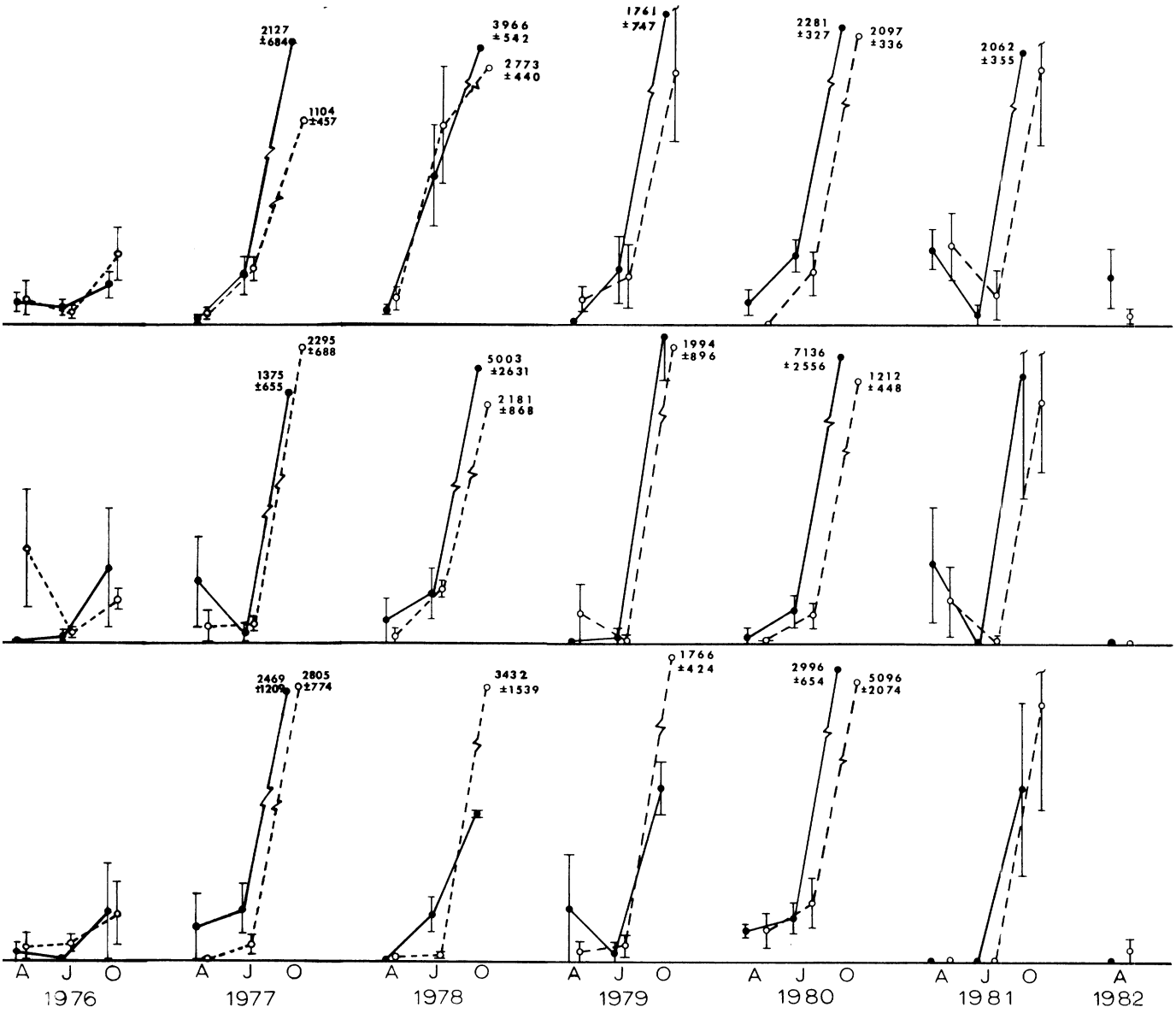


FIG. 4F. Mean abundances of coccoid blue-green algae in zones 0 - 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


2127 ±684
1104 ±457
3966 ±542
2773 ±440
1761 ±747
2281 ±327
2097 ±336
2062 ±355
1375 ±655
2295 ±688
5003 ±2631
2181 ±868
1994 ±896
7136 ±2556
1212 ±448
2469 ±1209
2805 ±774
3432 ±1539
1766 ±424
2996 ±654
5096 ±2074
A J O
1976
1977
1978
1979
1980
1981
A
1982

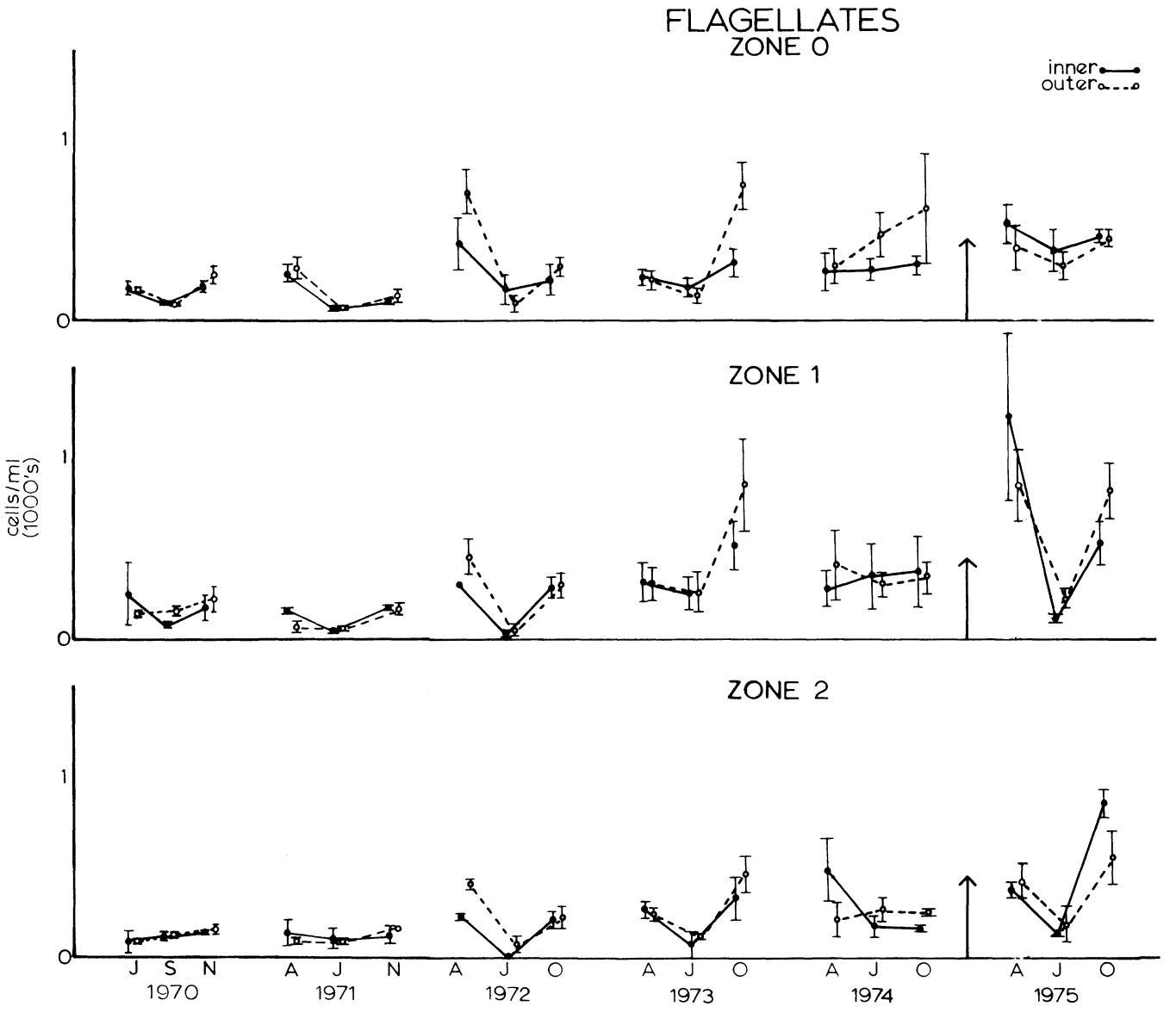
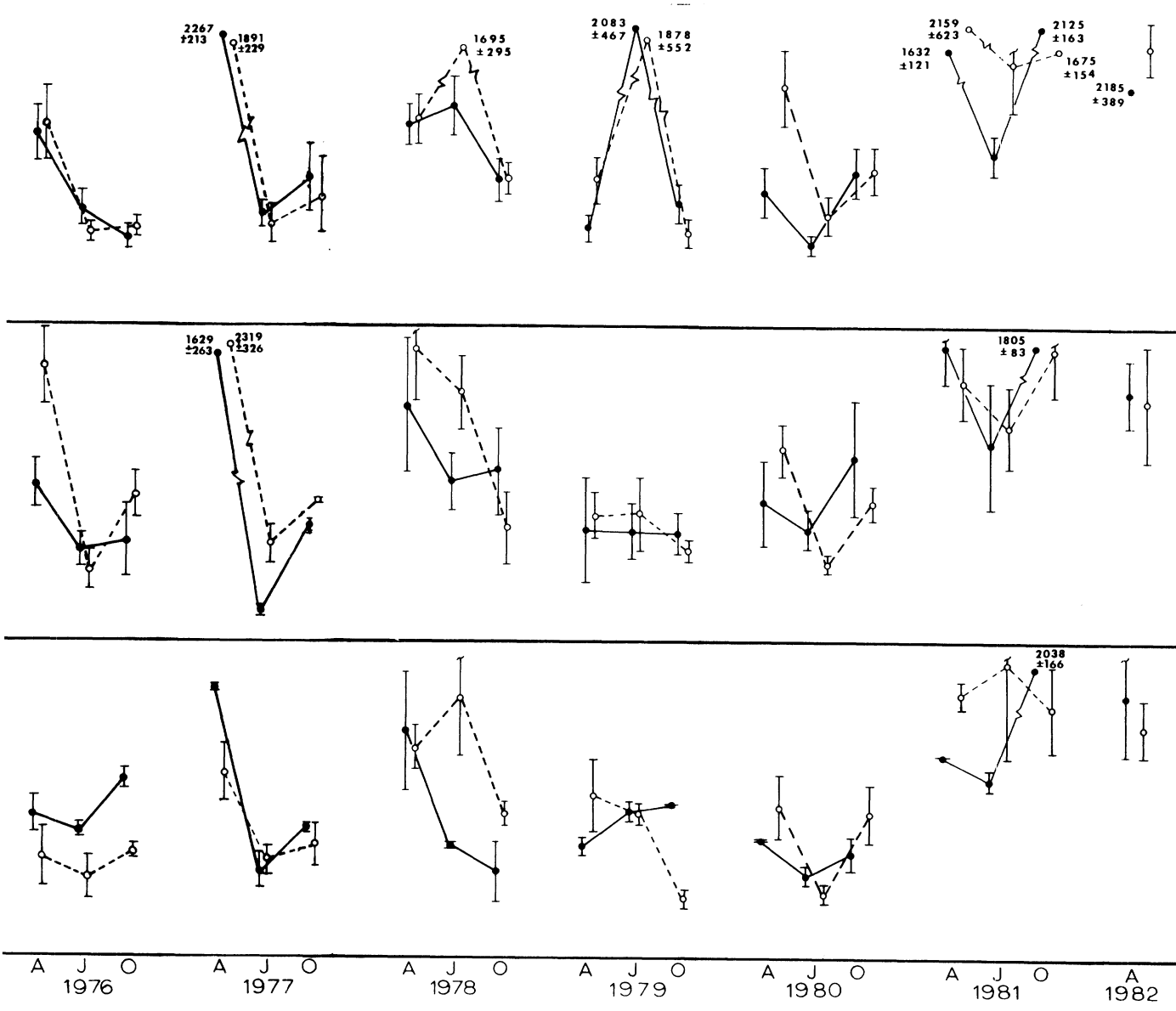


FIG. 4G. Mean abundances of flagellates in zones 0 - 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


2267
±213
1891
±229
1695
±295
2083
±467
1878
±552
2159
±623
2125
±163
1632
±121
1675
±154
2185
±389
1629
±263
2319
±326
1805
±83
2038
±166
A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

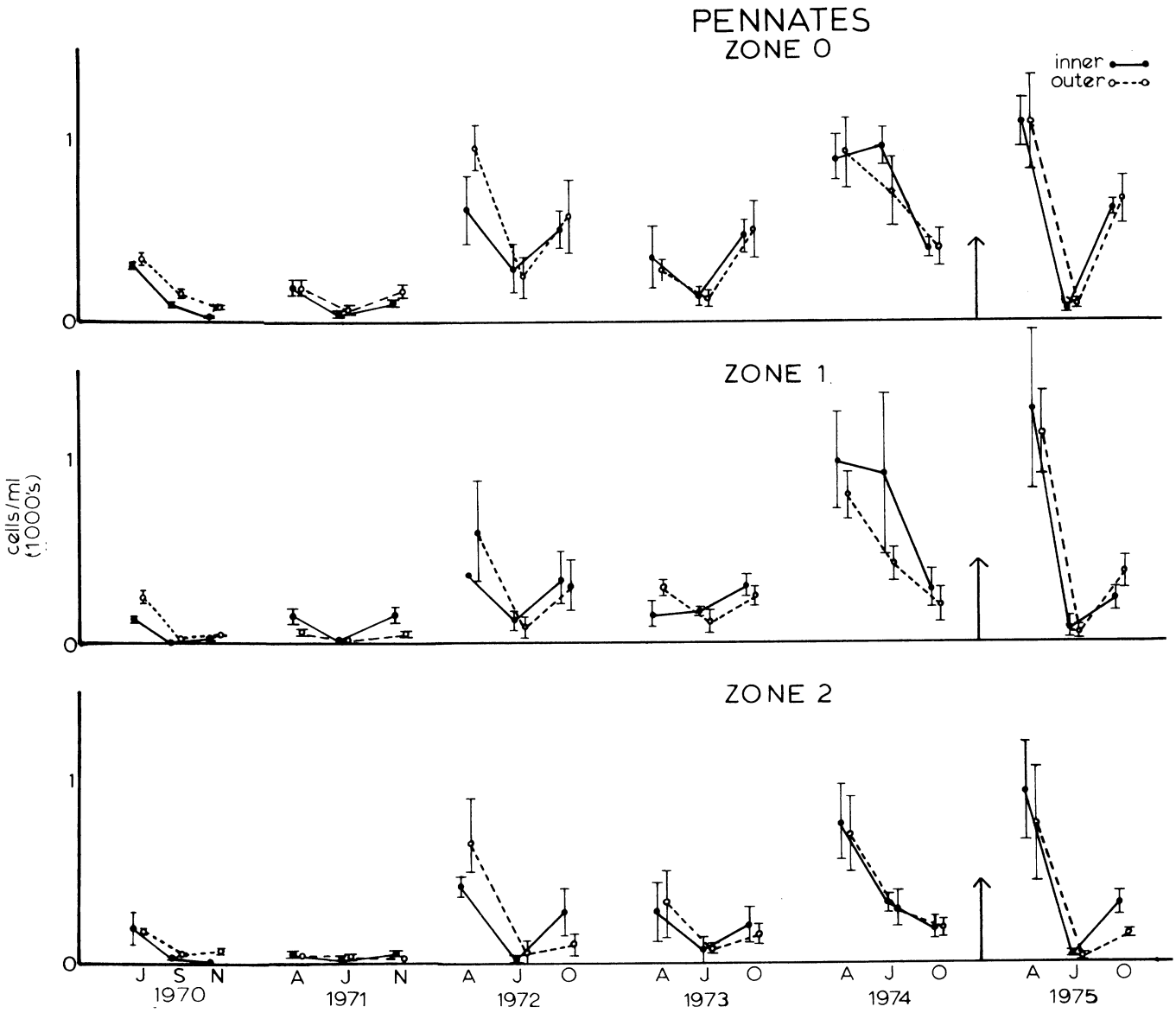
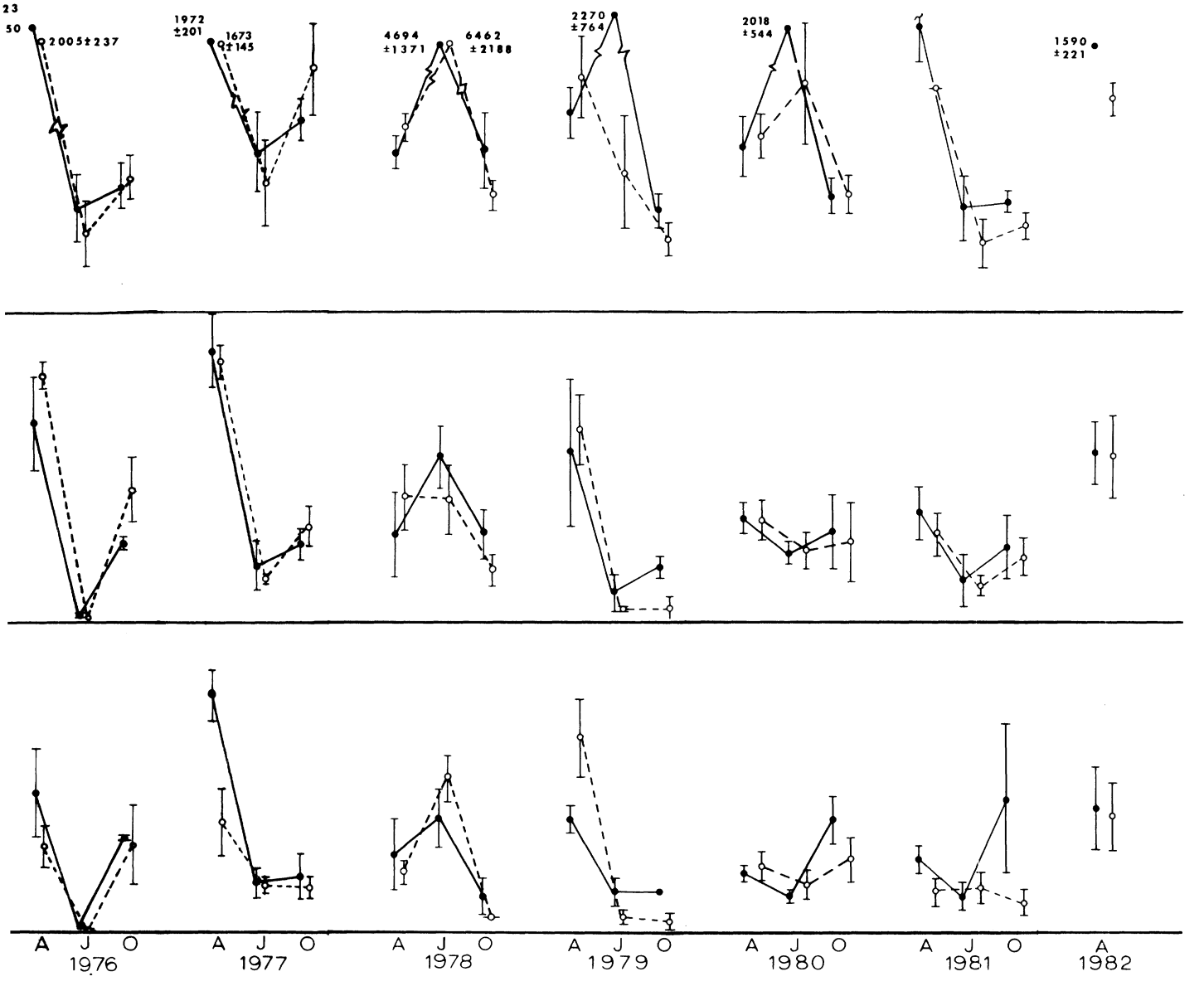


FIG. 4H. Mean abundances of pennate diatoms in zones 0 - 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


23
50
2005±237
1972
±201
1673
±145
4694
±1371
6462
±2188
2270
±764
2018
±544
1590
±221
A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

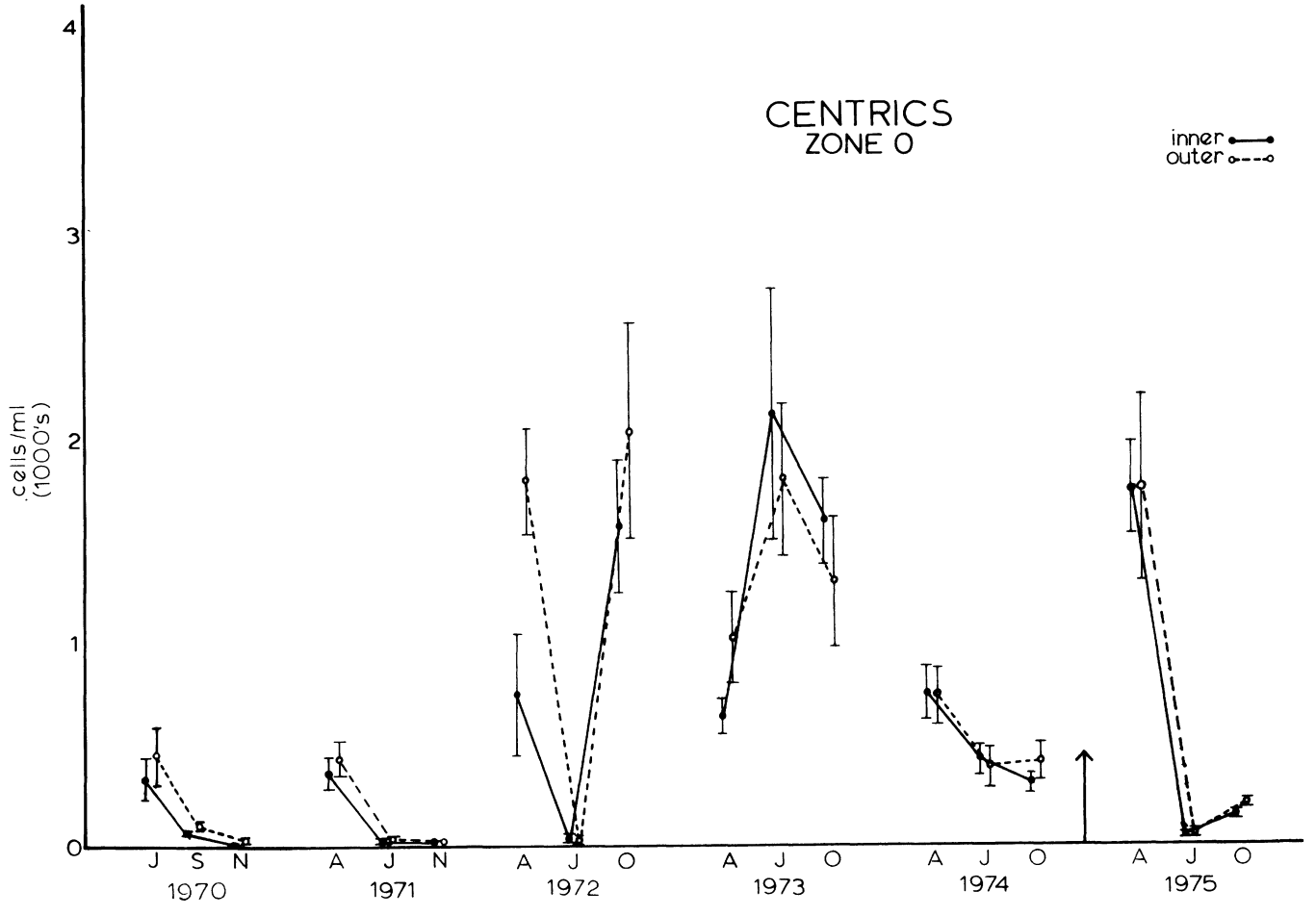
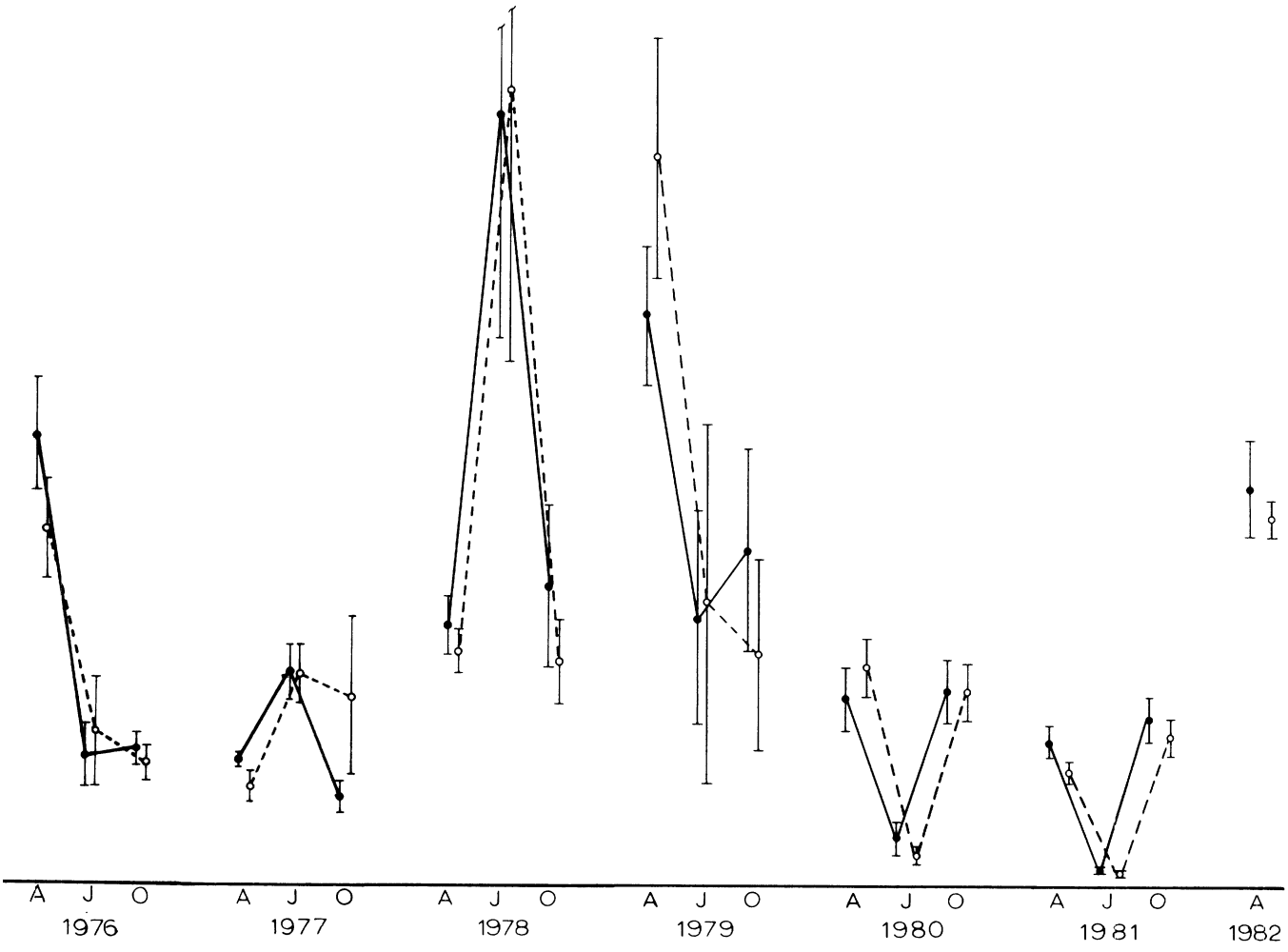


FIG. 4I. Mean abundances of centric diatoms in zone 0 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

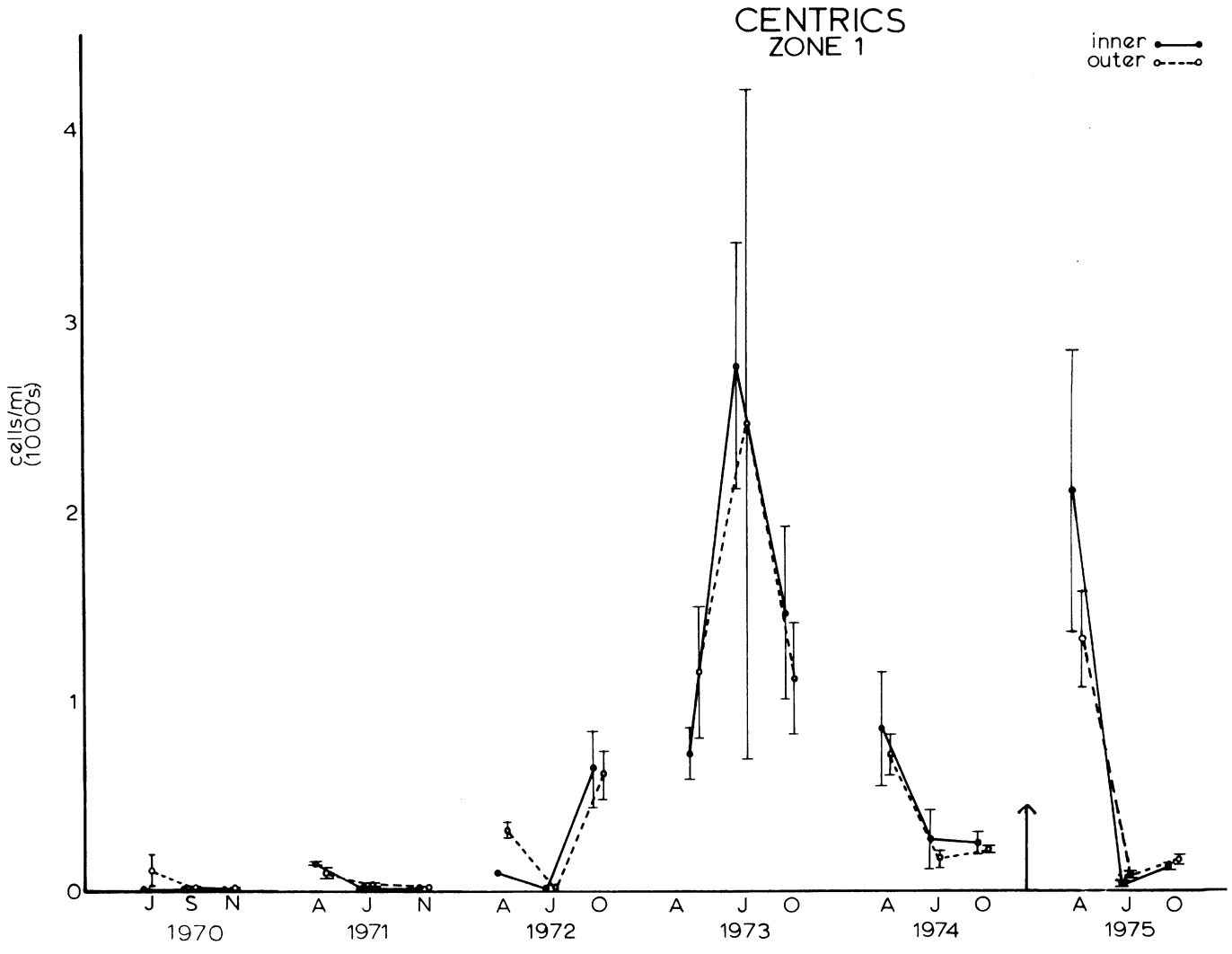
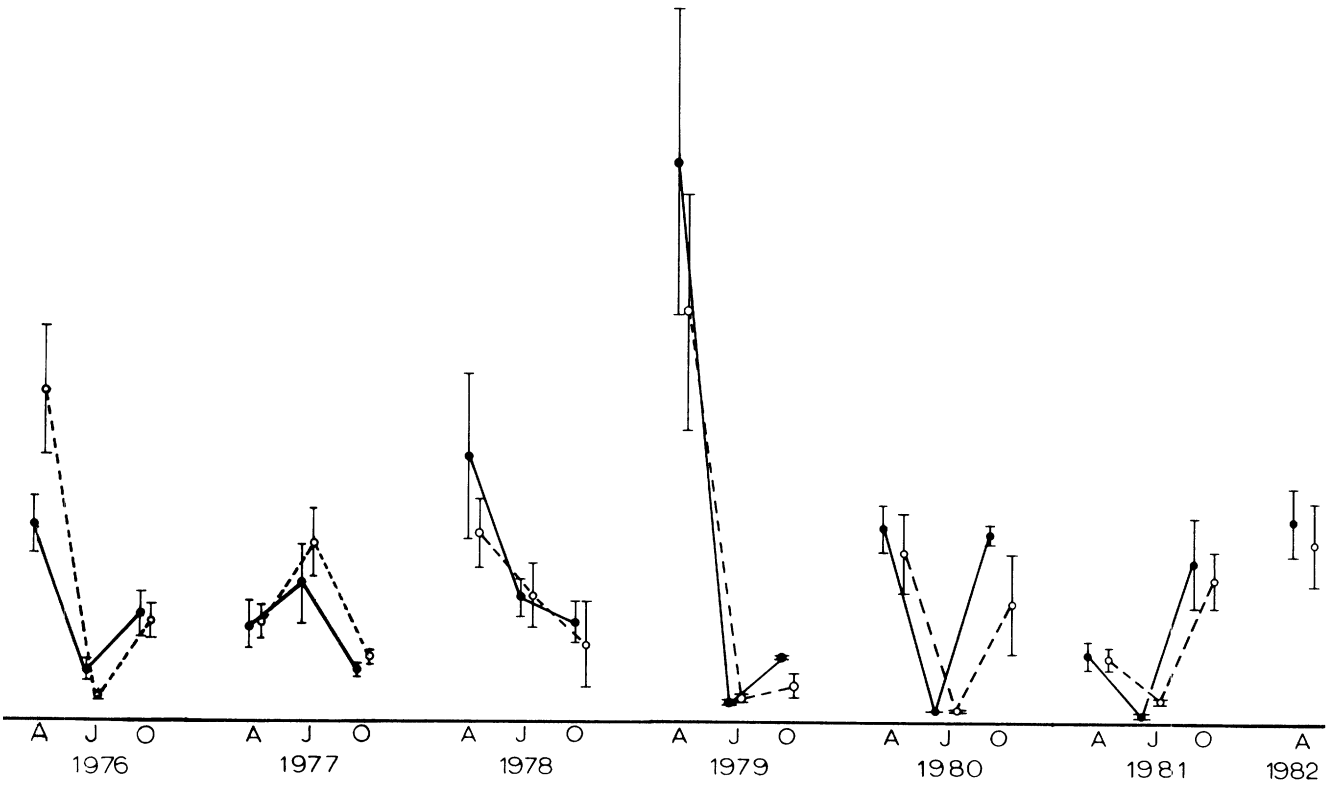


FIG. 4J. Mean abundances of centric diatoms in zone 1 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

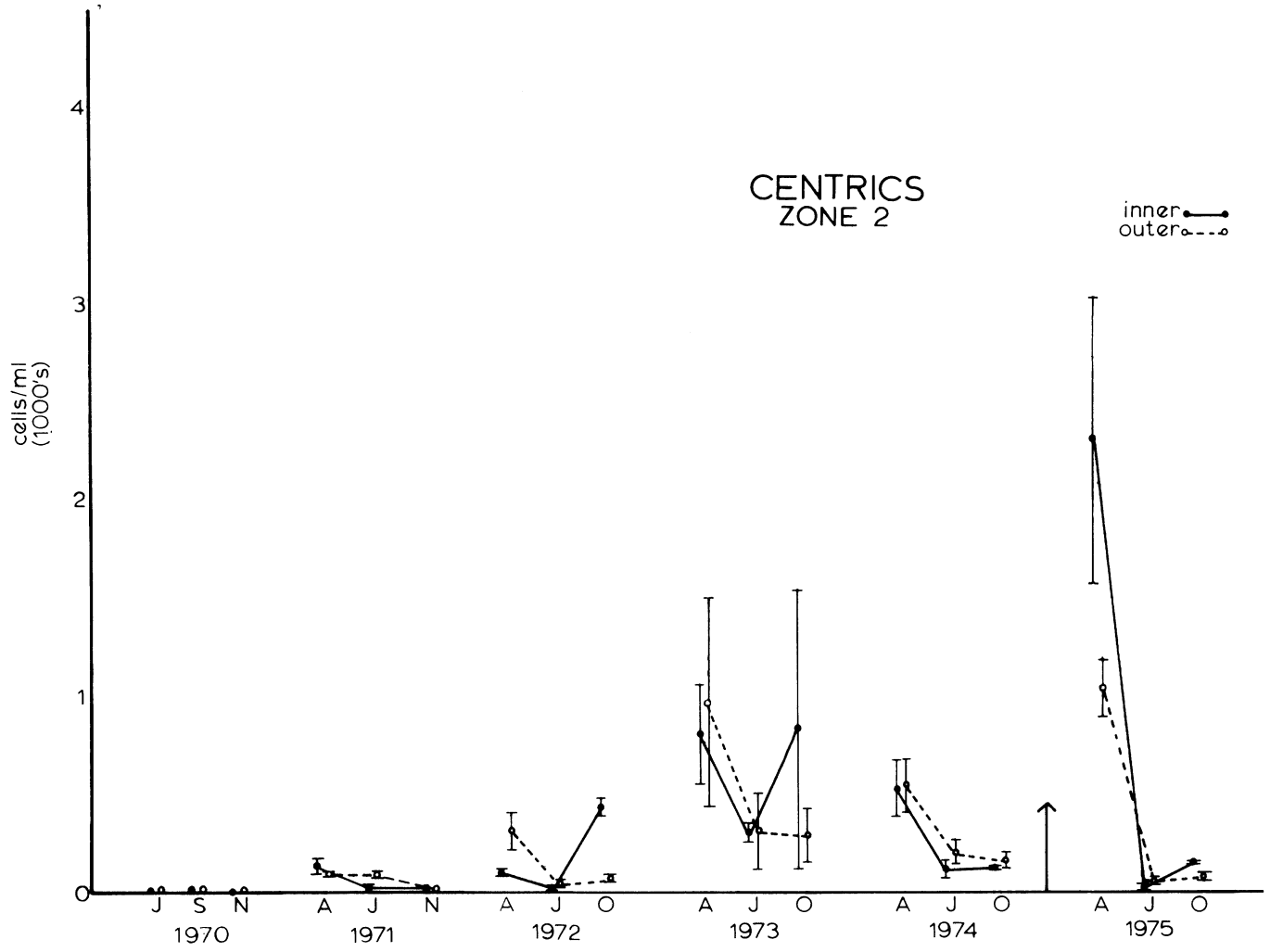
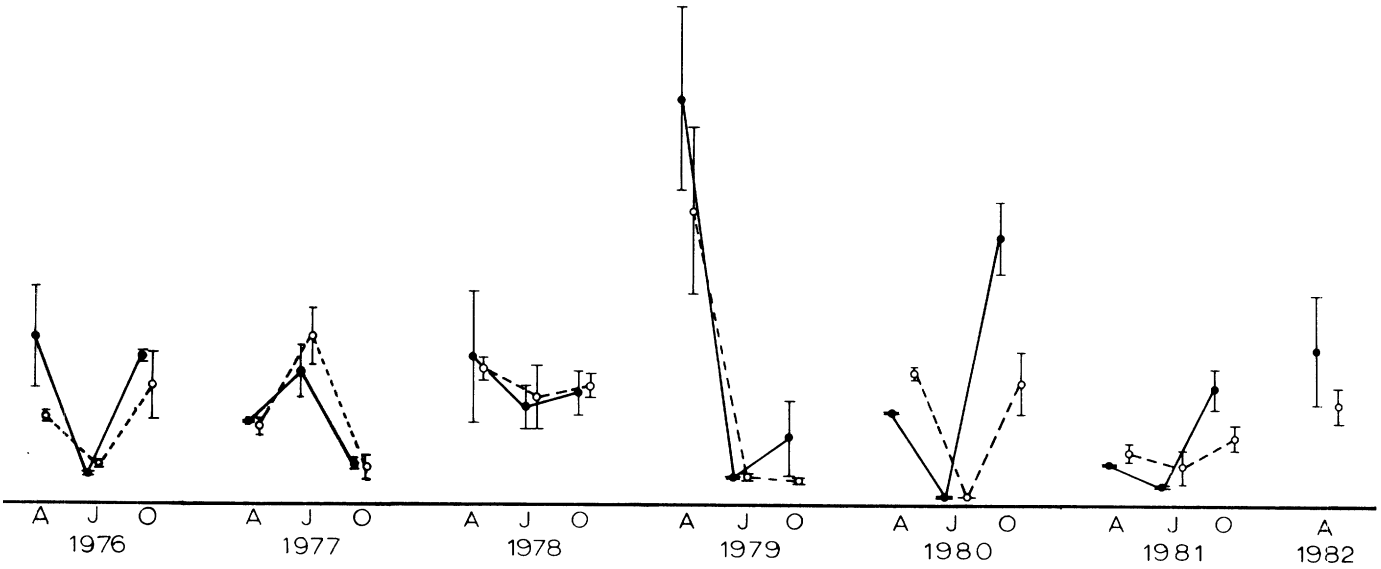


FIG. 4K. Mean abundances of centric diatoms in zone 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

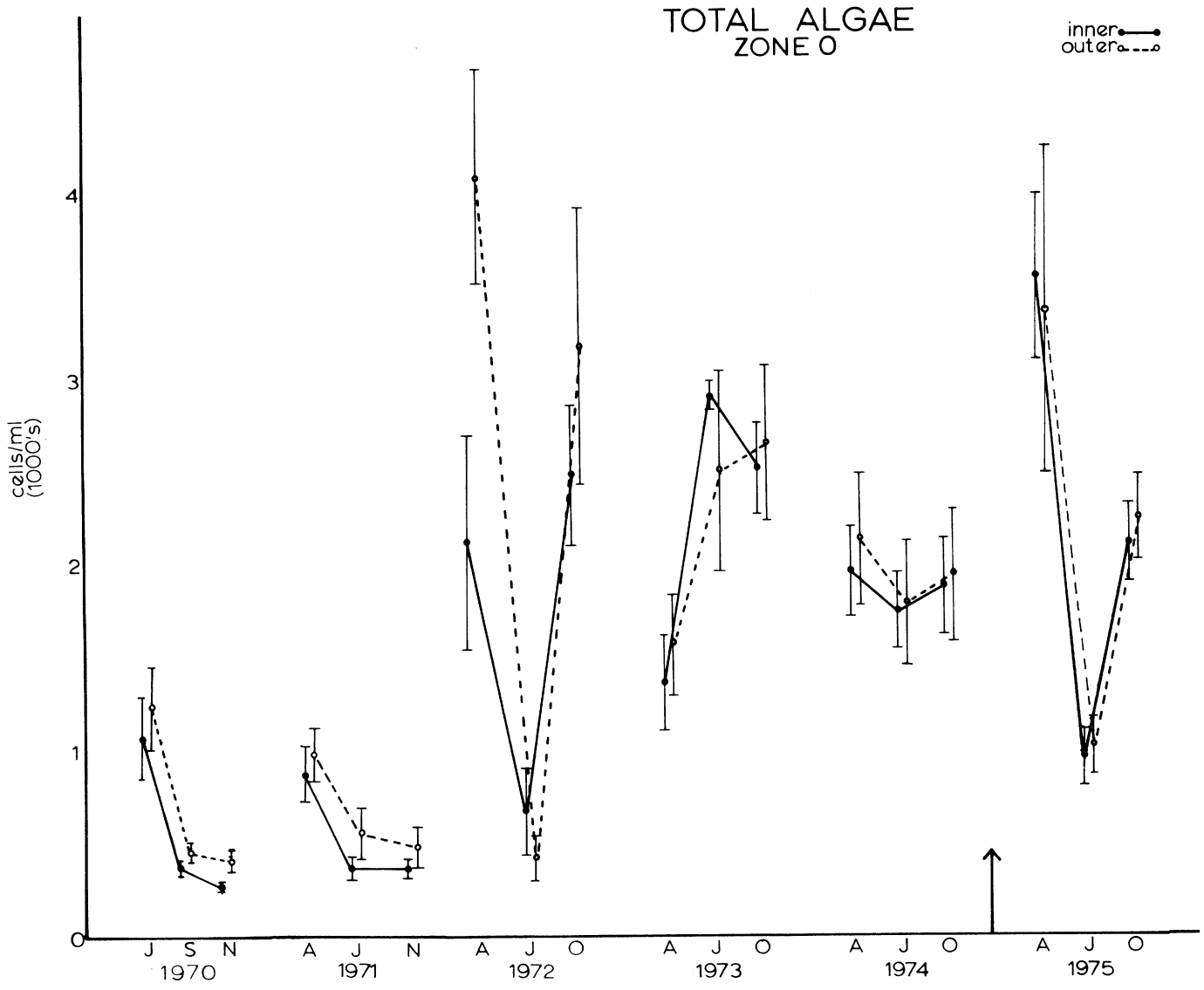
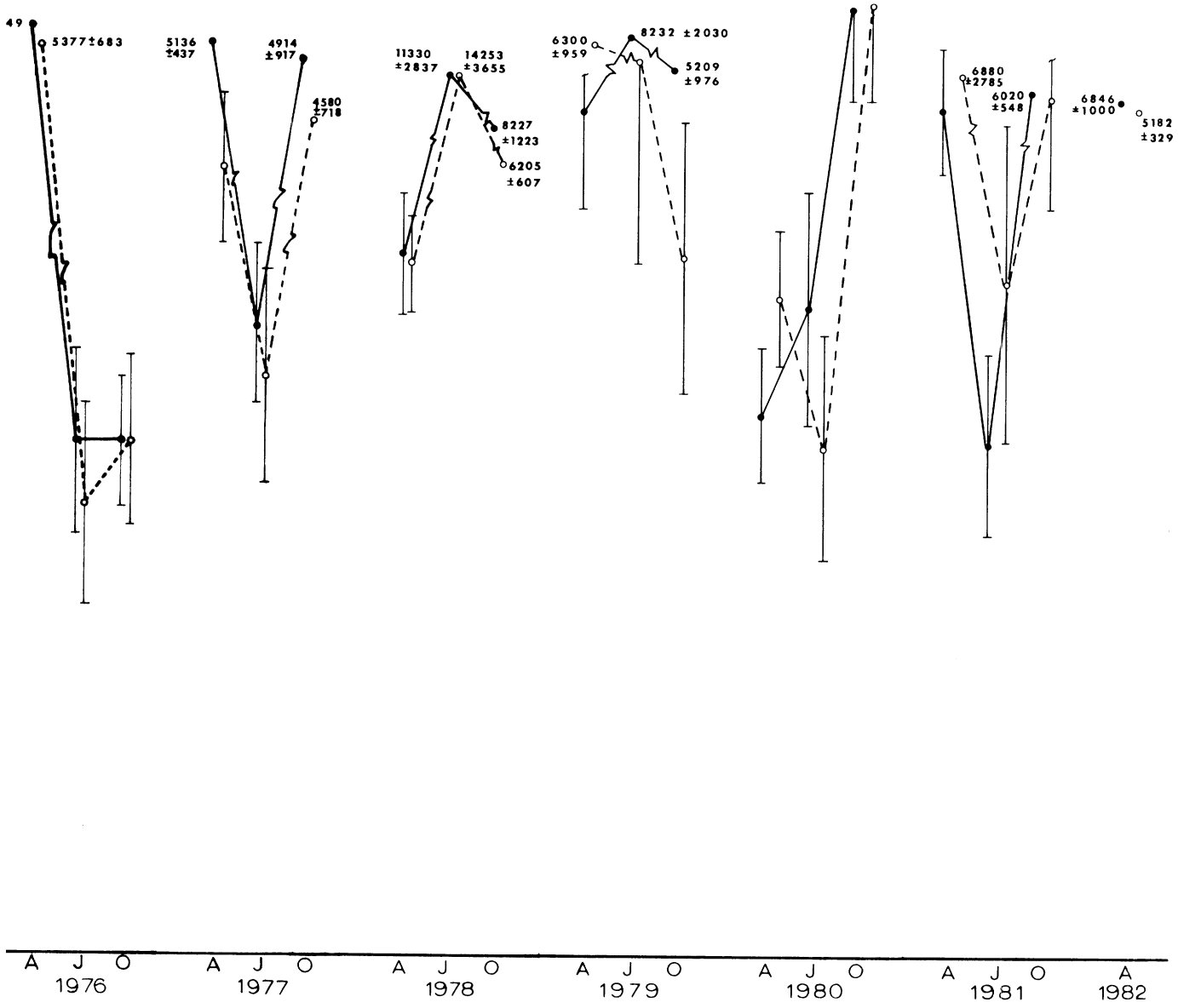


FIG. 4L. Mean abundances of total algae in zone 0 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


49
5377±683
5136
±437
4914
±917
4580
±718
11330
±2837
14253
±3655
8227
±1223
6205
±607
6300
±959
8232 ±2030
5209
±976
6880
±2785
6020
±548
6846
±1000
5182
±329
A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

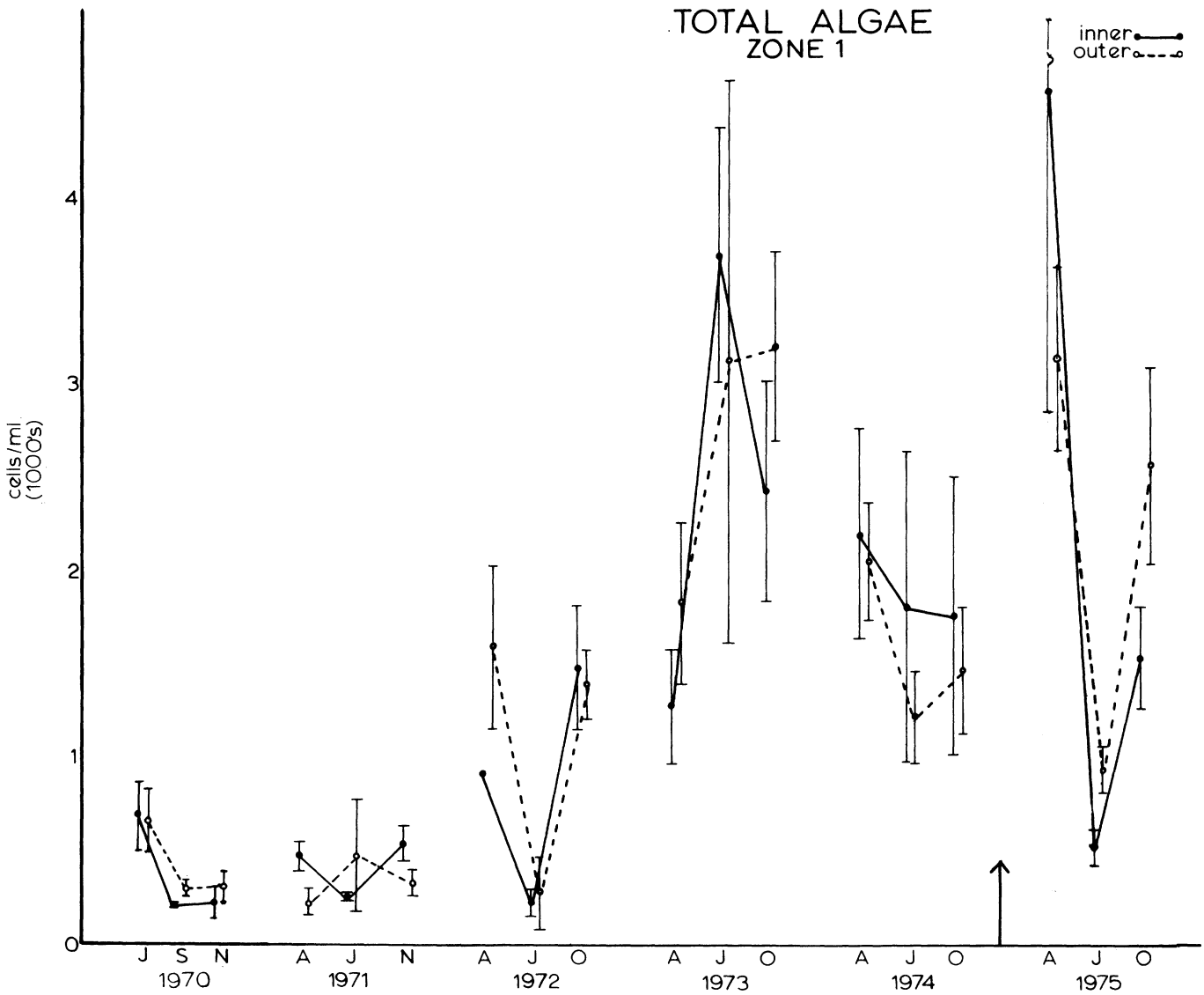
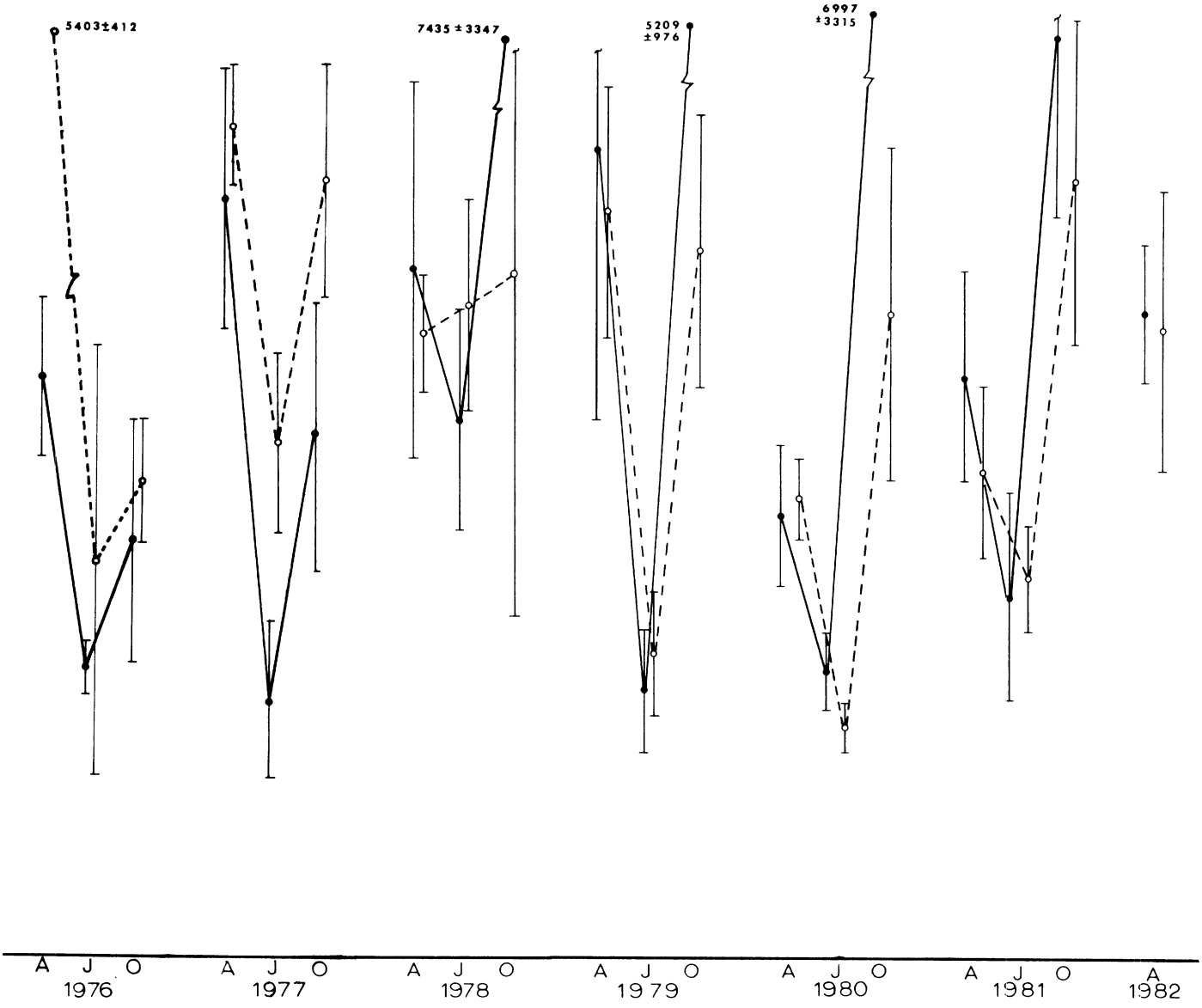


FIG. 4M. Mean abundances of total algae in zone 1 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


5403±412
7435±3347
5209
±976
6997
±3315
A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

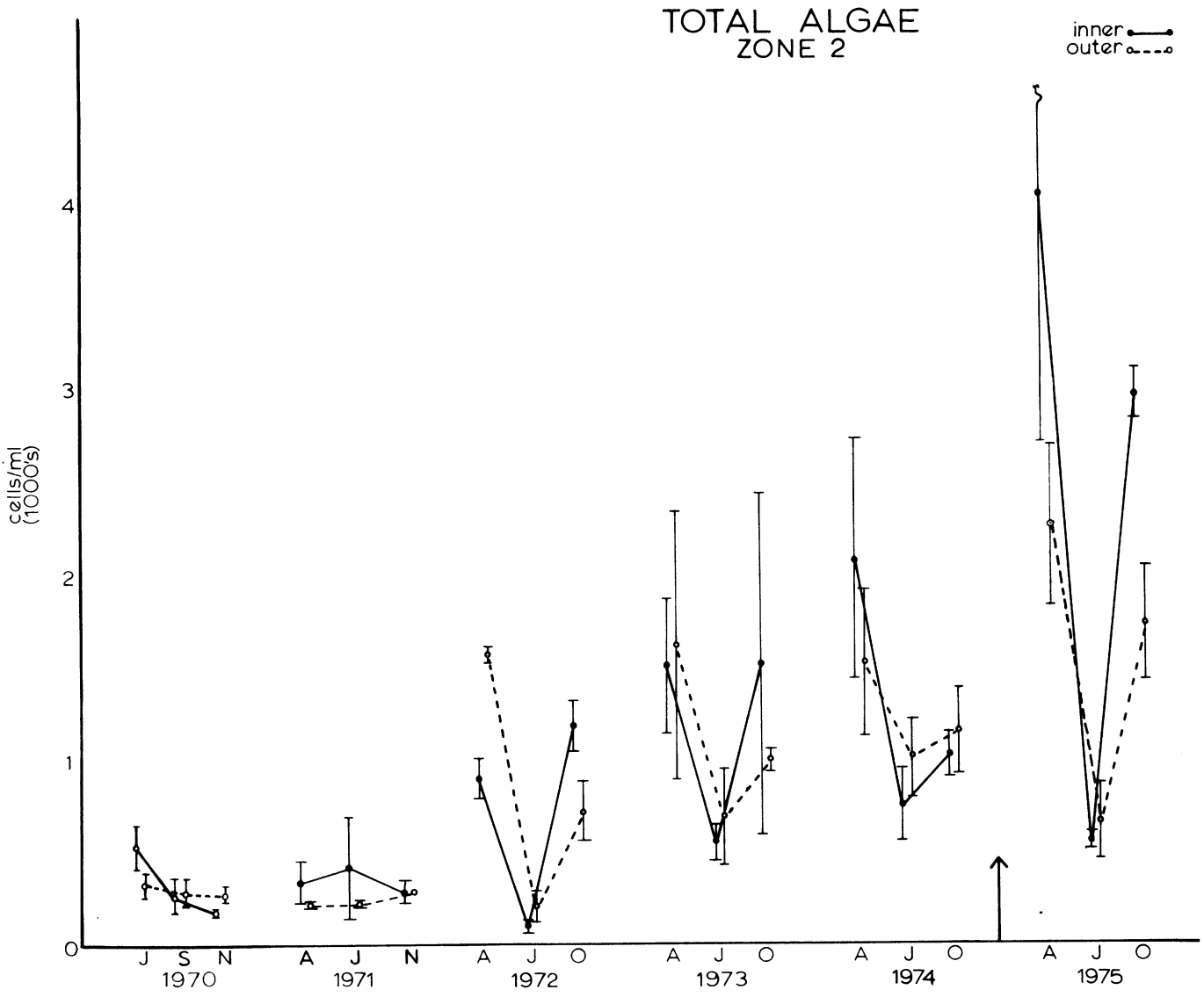
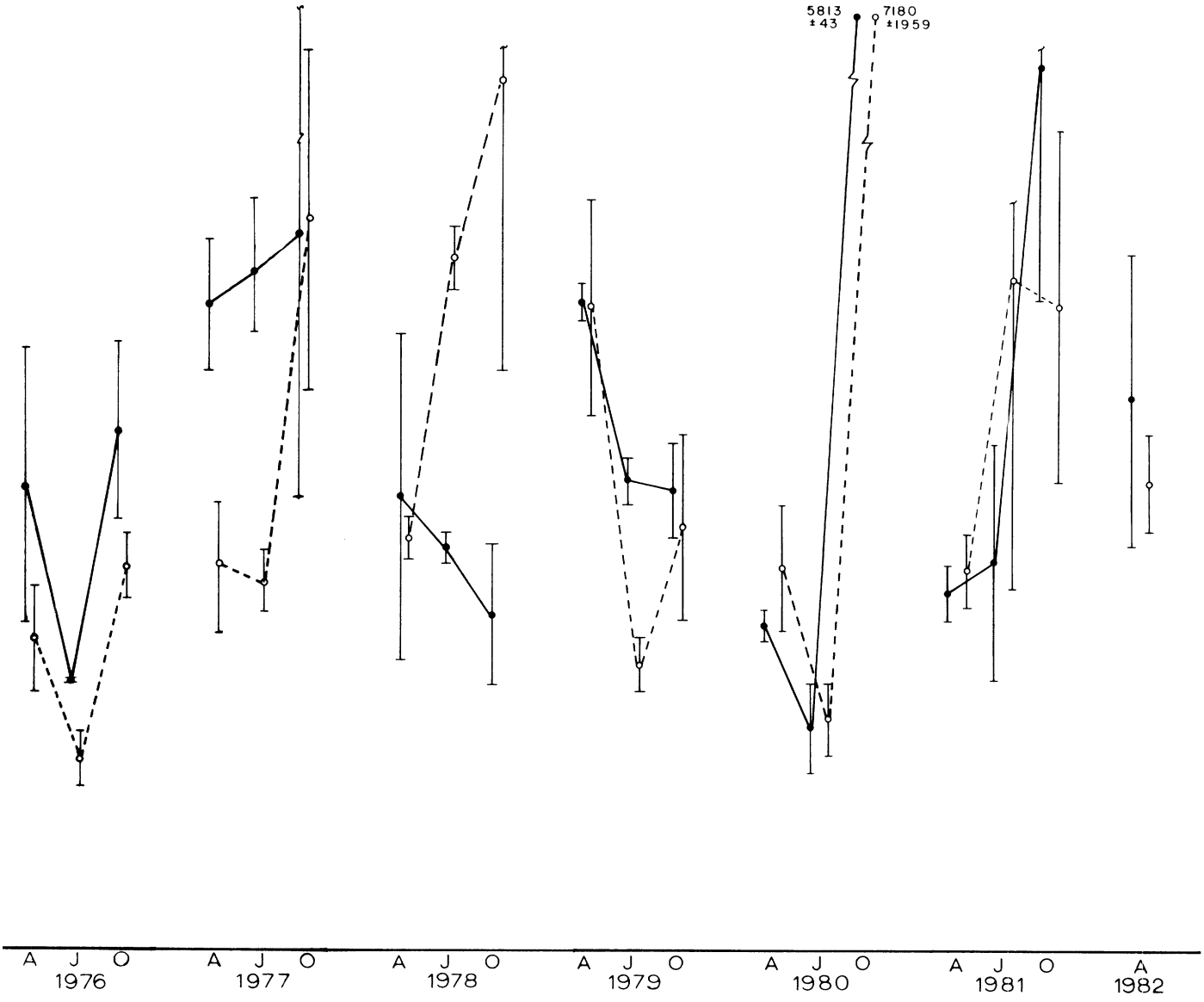


FIG. 4N. Mean abundances of total algae in zone 2 in the spring, summer, and fall seasonal surveys of 1970 through April 1982. The vertical bars show the standard errors. See Table 6 for numbers of observations.


5813
±43
7180
±1959
A J O
1976
A J O
1977
A J O
1978
A J O
1979
A J O
1980
A J O
1981
A
1982

diminution is less plain but 1981 is definitely less than 1978. In all zones spring mean numbers were the highest since spring 1979.

Total algae (Figs. 4L, 4M, 4N) in both station groups of zones 0 and 1 showed decreasing abundances from 1978 through 1981 after increasing from 1974 to 1978. Zone 2 showed these trends (but less clearly due to poor parallelism in the annual curves of 1977, 1978, 1979, and 1981), indeed, the rising trend in the early years appears to begin with 1971. The early-years rise and later-years decrease in total algae may be parts of a natural cycle of abundance, but it is interesting to note that the Great Lakes Water Quality Board (1981, p. 43) has reported to the International Joint Commission that the phosphorus loading of Lake Michigan went from its high of 2,339 tonnes/year in 1976 to 1,045 tonnes/year in 1980.

Inner-Outer Statistical Comparisons: Phytoplankton Abundances by Algal Categories

In the Environmental Operating Report for 1977 we reported statistical tests for significant differences in the mean abundances of ten algal categories at inner vs. outer station groups in three depth zones during the seasonal surveys of 1970 through 1977; each subsequent EOR has extended the tests through another year; and this section extends them through 1980, 1981, and April 1982.

The strategy was that if plant-caused effects on the phytoplankton were present they could be expected to show as consistent significant differences in overall cell densities between the inner and outer stations. Corollary to this was the possibility that plant operation might influence cell densities in one or more affected zones but not in others. Another corollary was that plant operation might act selectively upon one or a few of the ten categories of

algae, producing consistent significant differences in densities of the affected categories between inner and outer station groups.

For each season in each depth zone all available cell densities of each algal category were averaged to give seasonal mean abundances at the inner and outer station groups, and comparisons were made by two-sample t-test between inner and outer mean densities of each category in each depth zone.

Table 7 gives the means, variances, numbers of observations, and t-test of significance for each algal category in each season, station group, and depth zone during 1980, 1981, and April 1982.

During the period July 1970 through April 1982, 941 paired comparisons of inner vs. outer station group cell density means have been possible; 350 were from preoperational years and 591 were from operational years. During the entire period there have been a total of 49 cases of significant differences in mean cell densities between inner and outer station groups; these amount to 5.20% of the possible comparisons. In preoperational years there were 20 cases of significant differences out of 350 paired comparisons, amounting to 5.71% of the possible comparisons. In operational years there have been 29 cases out of 591 comparisons, amounting to 4.90% of the comparisons.

The following tabulation summarizes the distribution of the cases wherein there were significant (at the .05 or .01 levels) differences between mean densities of phytoplankton categories at inner vs. outer station groups. In each case the order of the abbreviations is: year, depth zone, season (Sp, Su, Fa), and I or O indicating which station group had the greater mean density of cells. Cases in operational years are underlined.

Coccoid blue-greens	75,Z2,Fa,I	78,Z2,Su,I	79,Z0,Sp,0	
Filamentous blue-greens	75,Z1,Su,0	75,Z2,Fa,I	76,Z2,Su,I	77,Z2,Su,I
Coccoid greens	70,Z2,Su,I 77,Z2,Su,I	71,Z2,Su,I	75,Z0,Fa,0	76,Z2,Fa,I
Filamentous greens		None		
Flagellates	71,Z1,Su,0 76,Z2,Fa,I 80,Z0,Sp,0	72,Z2,Sp,0 77,Z1,Su,0 80,Z1,Su,I	73,Z1,Fa,0 77,Z1,Fa,0	74,Z2,Fa,0 79,Z2,Fa,0
Centric diatoms	72,Z1,Sp,0 80,Z2,Sp,0	72,Z1,Fa,I	75,Z0,Fa,I	75,Z2,Fa,I
Pennate diatoms	70,Z1,Su,0 79,Z1,Fa,I	71,Z2,Su,0	73,Z1,Sp,0	75,Z2,Fa,I
Desmids	71,Z1,Su,0	71,Z2,Su,I		
Other algae	71,Z1,Sp,0 74,Z2,Sp,I 82,Z2,Sp,I	73,Z0,Sp,I 77,Z2,Fa,I	73,Z1,Su,I 80,Z1,Sp,0	73,Z2,Fa,I 81,Z0,Su,I
Total algae	72,Z0,Sp,0 78,Z2,Su,0	72,Z2,Sp,0 79,Z2,Su,I	76,Z1,Sp,0	77,Z2,Su,I

Summarized by years the numbers of significant differences were:

1970 (2 seasons)	2	1975	7*
1971	6	1976	4
1972	5	1977	6
1973	5	1978	2
1974	2	1979	4
		1980	4
		1981	1
		1982 (1 season)	1

*Erroneously reported as 6 in previous reports.

Although seven significant differences in 1975 is the highest yet found, it is small relative to the 78 paired comparisons of that year. The numbers of significant differences appear to be within the natural range of variation; no effect of plant operation is evident in this analysis.

Summarized by depth zones, with the station group having the greatest density indicated, and with operational years underlined, the cases of significant difference were:

TABLE 7. Algal abundances (cells/mL), by algal categories, at inner (treatment) and outer (control) station groups in three depth zones in Cook Plant seasonal surveys during 1980. In each season in each depth zone the mean count of cells/mL at inner stations is compared to that at outer stations using a two-sample t-test. Symbols used: n.s. = no significant difference between the two groups; * = significance at the .05 level; ** = significance at the .01 level; N = the number of stations for which data were available. No test was made if one of the groups contained only a single observation, or if one of the group variances was zero.

Survey	Station group	Zone 0 (0-8 m) Means	Variances	N	t-test	Zone 1 (8-16 m) Means	Variances	N	t-test	Zone 2 (16-24 m) Means	Variances	N	t-test
COCCOID BLUE-GREEN ALGAE													
Spring	Inner	123.25	58735.0	12	0.1330 n.s.	42.000	5292.0	3	0.4016 n.s.	165.80	2204.5	2	0.9730 n.s.
	Outer	2.6500	70.225	10		9.1000	156.34	4		170.77	33208.0	4	
Summer	Inner	371.61	83102.0	12	0.5755 n.s.	179.33	15799.0	3	0.8804 n.s.	247.70	14655.0	2	0.7471 n.s.
	Outer	293.63	$.12591 \times 10^6$	10		165.47	11349.0	4		323.65	81016.0	4	
Fall	Inner	2281.9	$.12908 \times 10^7$	12	0.7014 n.s.	4136.3	$.21153 \times 10^8$	3	0.2567 n.s.	2966.2	$.85792 \times 10^6$	2	0.9188 n.s.
	Outer	2097.9	$.11328 \times 10^7$	10		1212.4	$.80594 \times 10^6$	4		2703.8	$.10098 \times 10^8$	4	
FILAMENTOUS BLUE-GREEN ALGAE													
Spring	Inner	5.9417	30.843	12	0.2048 n.s.	2.7667	6.4633	3	0.6215 n.s.	31.500	1776.1	2	0.2062 n.s.
	Outer	11.260	161.85	10		5.8000	90.780	4		3.7250	11.502	4	
Summer	Inner	99.700	15607.0	12	0.2646 n.s.	97.833	3423.4	3	0.9402 n.s.	87.050	999.04	2	0.6900 n.s.
	Outer	200.79	74946.0	10		102.92	9608.2	4		110.15	4819.8	4	
Fall	Inner	32.317	3846.2	12	0.7215 n.s.	75.167	4778.1	3	0.9332 n.s.	82.900	9688.3	2	0.6658 n.s.
	Outer	41.130	2502.6	10		82.900	18828.0	4		49.000	6200.1	4	
COCCOID GREEN ALGAE													
Spring	Inner	180.17	62333.0	12	0.6305 n.s.	21.567	256.50	3	0.2490 n.s.	37.350	34.445	2	0.3207 n.s.
	Outer	132.32	40074.0	10		7.4500	163.71	4		22.775	282.99	4	
Summer	Inner	97.400	3801.8	12	0.3396 n.s.	86.500	290.47	3	0.4117 n.s.	107.15	4503.0	2	0.9569 n.s.
	Outer	131.64	10198.0	10		128.17	5999.5	4		104.25	3028.3	4	
Fall	Inner	193.84	7409.1	12	0.0676 n.s.	205.63	33326.0	3	0.9414 n.s.	116.10	7938.0	2	0.5419 n.s.
	Outer	334.11	54788.0	10		197.72	7670.6	4		162.20	5874.2	4	
FILAMENTOUS GREEN ALGAE													
Spring	Inner	.55000	3.6300	12	0.4588 n.s.	0	0	3		9.1000	165.62	2	
	Outer	1.9900	39.601	10		0	0	4		0	0	4	
Summer	Inner	0	0	12		.26667	.21333	3		0	0	2	
	Outer	0.1700	0.28900	10		0	0	4		0.82500	2.7225	4	
Fall	Inner	8.5583	72.950	12	0.2726 n.s.	1.1000	3.6300	3	0.4132 n.s.	0	0	2	
	Outer	18.250	805.54	10		41.450	5843.5	4		2.4750	9.9825	4	
FLAGELLATES													
Spring	Inner	743.77	$.28155 \times 10^6$	12	0.0278 *	764.37	$.16674 \times 10^6$	3	0.2278 n.s.	651.60	137.78	2	0.4498 n.s.
	Outer	1308.9	$.45586 \times 10^6$	10		1067.4	27751.0	4		872.57	$.12378 \times 10^6$	4	
Summer	Inner	447.87	30262.0	12	0.2030 n.s.	618.47	28073.0	3	0.0365 *	459.25	2485.1	2	0.2155 n.s.
	Outer	600.55	$.12608 \times 10^6$	10		348.20	7282.1	4		356.47	7861.7	4	
Fall	Inner	843.82	$.21733 \times 10^6$	12	0.9262 n.s.	1013.6	$.30888 \times 10^6$	3	0.4056 n.s.	572.05	13203.0	2	0.6673 n.s.
	Outer	861.05	$.14354 \times 10^6$	10		759.80	17487.0	4		717.32	$.17042 \times 10^6$	4	

TABLE 7. Continued.

Survey	Station group	Zone 0 (0-8 m) Means	Variances	N	t-test	Zone 1 (8-16 m) Means	Variances	N	t-test	Zone 2 (16-24 m) Means	Variances	N	t-test
CENTRIC DIATOMS													
Spring	Inner	914.97	$.28155 \times 10^6$	12	0.4158 n.s.	985.43	35452.0	3	0.4733 n.s.	438.55	1.4450	2	0.0256 *
	Outer	1088.3	$.18347 \times 10^6$	10		799.57	$.14059 \times 10^6$	4		630.07	5413.4	4	
Summer	Inner	246.43	64593.0	12	0.2944 n.s.	53.633	30.243	3	0.8505 n.s.	42.100	776.18	2	0.9551 n.s.
	Outer	150.22	17846.0	10		56.375	524.84	4		43.125	262.11	4	
Fall	Inner	966.79	$.30453 \times 10^6$	12	0.9980 n.s.	889.83	6642.6	3	0.2867 n.s.	1253.5	54979.0	2	0.0663 n.s.
	Outer	967.32	$.17774 \times 10^6$	10		555.47	$.22036 \times 10^6$	4		522.00	$.13313 \times 10^6$	4	
PENNATE DIATOMS													
Spring	Inner	936.81	$.32572 \times 10^6$	12	0.7791 n.s.	581.97	27211.0	3	0.9477 n.s.	317.55	2093.0	2	0.7054 n.s.
	Outer	999.15	$.18454 \times 10^6$	10		572.00	41660.0	4		368.52	27302.0	4	
Summer	Inner	2018.0	$.35455 \times 10^6$	12	0.2971 n.s.	395.17	13660.0	3	0.9523 n.s.	223.20	1568.0	2	0.6835 n.s.
	Outer	1290.1	$.12701 \times 10^7$	10		403.95	46668.0	4		277.10	26304.0	4	
Fall	Inner	649.96	$.11646 \times 10^6$	12	0.9161 n.s.	510.70	$.12512 \times 10^6$	3	0.8606 n.s.	643.35	38781.0	2	0.3000 n.s.
	Outer	665.38	$.11072 \times 10^6$	10		452.22	$.20241 \times 10^6$	4		438.55	39767.0	4	
DESMIDS													
Spring	Inner	.82500	4.2075	12	0.8584 n.s.	1.1000	3.6300	3	0.3793 n.s.	0	0	2	
	Outer	.99000	4.9610	10		3.7250	18.762	4		3.7250	55.502	4	
Summer	Inner	.40833	1.4045	12	0.1425 n.s.	.83333	.72333	3	0.3762 n.s.	.40000	0	2	
	Outer	1.4900	4.3677	10		2.1000	4.3800	4		1.1250	.87583	4	
Fall	Inner	.82500	2.2275	12	0.8379 n.s.	0	0	3		0	0	2	
	Outer	.99000	4.9610	10		.42500	.72250	4		1.0250	2.4425	4	
OTHER ALGAE													
Spring	Inner	67.283	8173.8	12	0.7181 n.s.	4.4000	25.410	3	0.0445 *	114.40	16021.0	2	0.1552 n.s.
	Outer	81.570	8465.6	10		43.950	611.42	4		17.400	129.78	4	
Summer	Inner	189.37	25355.0	12	0.4349 n.s.	127.67	3358.9	3	0.0542 n.s.	54.700	12.500	2	0.5105 n.s.
	Outer	137.81	19747.0	10		47.650	676.64	4		44.775	332.14	4	
Fall	Inner	243.17	19167.0	12	0.6418 n.s.	168.00	16232.0	3	0.6776 n.s.	179.05	17242.0	2	0.2960 n.s.
	Outer	280.20	51041.0	10		198.12	2504.7	4		99.775	1998.0	4	
TOTAL ALGAE													
Spring	Inner	2973.6	$.16490 \times 10^7$	12	0.2332 n.s.	2403.7	$.42064 \times 10^6$	3	0.8032 n.s.	1765.8	11145.0	2	0.5754 n.s.
	Outer	3627.2	$.14106 \times 10^7$	10		2509.0	$.17889 \times 10^6$	4		2089.6	$.49853 \times 10^6$	4	
Summer	Inner	3470.8	$.51038 \times 10^7$	12	0.4772 n.s.	1559.7	$.13143 \times 10^6$	3	0.2422 n.s.	1221.5	$.11602 \times 10^6$	2	0.9081 n.s.
	Outer	2806.4	$.39565 \times 10^7$	10		1254.9	63368.0	4		1261.5	$.14899 \times 10^6$	4	
Fall	Inner	5221.2	$.32048 \times 10^7$	12	0.9523 n.s.	7000.3	$.33031 \times 10^8$	3	0.2929 n.s.	5813.2	3715.2	2	0.7092 n.s.
	Outer	5266.3	$.28091 \times 10^7$	10		3500.6	$.33251 \times 10^7$	4		4696.1	$.13823 \times 10^8$	4	

TABLE 7. Algal abundances (cells/mL), by algal categories, at inner (treatment) and outer (control) station groups in three depth zones in April, July, and October of 1981. In each season in each depth zone the mean count of cells/mL at inner stations is compared to that at outer stations using a two-sample t-test. Symbols used: n.s. = no significant difference between the two groups; * = significance at the .05 level; ** = significance at the .01 level; and N = the number of stations for which data were available. No test was made if one of the groups contained only a single observation, or if one of the group variances was zero.

Survey	Station	Zone 0 (0-8m)				Zone 1 (8-16m)				Zone 2 (16-24m)			
		Means	Variance	N	t-test	Means	Variance	N	t-test	Means	Variance	N	t-test
COCCOID BLUE-GREEN ALGAE													
Spring	Inner	389.09	$.15056 \times 10^6$	12	0.8591 n.s.	445.47	$.31116 \times 10^6$	3	0.5979 n.s.	0	0	2	
	Outer	427.13	$.35839 \times 10^6$	10		248.72	$.14187 \times 10^6$	4		4.1500	68.890	4	
Summer	Inner	42.833	22016	12	0.4088 n.s.	7.2000	155.52	3	0.5409 n.s.	0	0	2	
	Outer	155.86	$.19063 \times 10^6$	10		26.525	2376.5	4		0	0	4	
Fall	Inner	2062.3	$.15195 \times 10^7$	12	0.2359 n.s.	1469.0	$.13463 \times 10^7$	3	0.8350 n.s.	958.35	$.46880 \times 10^6$	2	0.6520 n.s.
	Outer	1394.8	$.17593 \times 10^7$	10		1311.9	$.56655 \times 10^6$	4		1402.3	$.13233 \times 10^7$	4	
FILAMENTOUS BLUE-GREEN ALGAE													
Spring	Inner	17.692	172.89	12	0.2242 n.s.	11.033	69.853	3	0.8174 n.s.	26.500	792.02	2	0.1475 n.s.
	Outer	28.340	662.15	10		9.5250	63.149	4		4.5500	2.5100	4	
Summer	Inner	977.02	$.14733 \times 10^7$	12	0.3625 n.s.	434.43	$.12641 \times 10^6$	3	0.9426 n.s.	803.30	$.93107 \times 10^6$	2	0.7685 n.s.
	Outer	1510.8	$.21767 \times 10^7$	10		456.17	$.15163 \times 10^6$	4		1232.8	$.29929 \times 10^6$	4	
Fall	Inner	17.667	579.99	12	0.8377 n.s.	72.933	15247	3	0.3699 n.s.	24.850	666.12	2	0.1037 n.s.
	Outer	20.550	1632.3	10		12.425	617.52	4		1.2500	2.5000	4	
COCCOID GREEN ALGAE													
Spring	Inner	88.983	4739.1	12	0.3008 n.s.	27.633	1146.3	3	0.9723 n.s.	41.450	2429.0	2	0.6496 n.s.
	Outer	1005.4	$.90163 \times 10^7$	10		28.625	1350.1	4		24.875	1221.9	4	
Summer	Inner	156.07	19672.	12	0.5385 n.s.	112.47	28797.	3	0.6959 n.s.	15.750	496.13	2	0.3677 n.s.
	Outer	112.59	34447.	10		77.525	1135.8	4		292.22	$.13186 \times 10^6$	4	
Fall	Inner	197.03	24023.	12	0.4416 n.s.	259.80	46764.	3	0.3757 n.s.	289.35	2541.8	2	0.0897 n.s.
	Outer	250.70	27282.	10		142.60	10361.	4		129.75	8267.2	4	
FILAMENTOUS GREEN ALGAE													
Spring	Inner	0.5500	3.6300	12	0.8985 n.s.	0	0	3		9.1500	34.445	2	
	Outer	0.6600	4.3560	10		.42500	.72250	4		0	0	4	
Summer	Inner	1.9333	16.953	12	0.5907 n.s.	5.0000	52.390	3	0.8355 n.s.	7.0500	57.245	2	0.5110 n.s.
	Outer	3.1500	39.347	10		4.1500	8.2233	4		3.7250	18.762	4	
Fall	Inner	3.4500	16.259	12	0.2696 n.s.	.56667	.96333	3	0.8213 n.s.	6.6500	88.445	2	
	Outer	1.8200	5.1107	10		.82500	2.7225	4		0	0		
FLAGELLATES													
Spring	Inner	1632.9	$.17796 \times 10^6$	12	0.3764 n.s.	1620.5	$.12673 \times 10^6$	3	0.5474 n.s.	1219.5	112.50	2	0.0813 n.s.
	Outer	2159.6	$.38914 \times 10^7$	10		1427.6	$.17101 \times 10^6$	4		1464.9	19883.	4	
Summer	Inner	940.68	$.14015 \times 10^6$	12	0.1022 n.s.	1094.3	$.36598 \times 10^6$	3	0.8405 n.s.	986.15	6647.0	2	0.4577 n.s.
	Outer	1484.8	$.10520 \times 10^7$	10		1176.2	$.18244 \times 10^6$	4		1637.4	$.11162 \times 10^7$	4	
Fall	Inner	2125.6	$.32255 \times 10^6$	12	0.0628 n.s.	1805.6	20696.	3	0.5536 n.s.	2038.6	55511.	2	0.1604 n.s.
	Outer	1675.5	$.23863 \times 10^6$	10		1602.1	$.27991 \times 10^6$	4		1399.8	$.22654 \times 10^6$	4	

TABLE 7. Continued.

Survey	Station	Zone 0 (0-8m) Means	Variance	N	t-test	Zone 1 (8-16m) Means	Variance	N	t-test	Zone 2 (16-24m) Means	Variance	N	t-test
CENTRIC DIATOMS													
Spring	Inner	702.74	66474.	12	0.1378 n.s.	333.83	12060.	3	0.8067 n.s.	185.70	87.120	2	0.3352 n.s.
	Outer	559.43	22911.	10		313.37	9918.3	4		245.80	5330.5	4	
Summer	Inner	76.133	7279.8	12	0.5547 n.s.	42.267	2137.4	3	0.0536 n.s.	88.700	12.500	2	0.4773 n.s.
	Outer	57.360	2937.5	10		115.22	983.56	4		179.07	23670.	4	
Fall	Inner	824.20	$.12549 \times 10^6$	12	0.5578 n.s.	767.13	$.12691 \times 10^6$	3	0.7126 n.s.	542.20	19130.	2	0.0907 n.s.
	Outer	742.15	76285.	10		676.87	68444.	4		309.65	13146.	4	
PENNATE DIATOMS													
Spring	Inner	1603.3	$.48760 \times 10^6$	12	0.2217 n.s.	603.53	62508.	3	0.6535 n.s.	408.70	10397.	2	0.2259 n.s.
	Outer	1267.4	$.26372 \times 10^6$	10		518.55	49015.	4		248.72	18773.	4	
Summer	Inner	593.87	$.41112 \times 10^6$	12	0.3740 n.s.	247.03	53188.	3	0.7384 n.s.	211.80	11766.	2	0.7770 n.s.
	Outer	379.69	$.17004 \times 10^6$	10		202.90	9170.1	4		254.50	31400.	4	
Fall	Inner	613.62	49851.	12	0.2125 n.s.	502.97	36165.	3	0.3919 n.s.	768.50	$.35617 \times 10^6$	2	0.1013 n.s.
	Outer	487.81	54731.	10		361.85	40740.	4		189.82	13682.	4	
DESMIDS													
Spring	Inner	.82500	4.2075	12	0.3509 n.s.	0	0	3		1.6500	5.4450	2	0.3632 n.s.
	Outer	1.9800	12.584	10		1.6500	10.890	4		.42500	.72250	4	
Summer	Inner	.14167	.24083	12		.56667	.96333	3	0.4007 n.s.	0	0	2	
	Outer	0	0	10		1.4500	2.0033	4		2.5000	8.3333	4	
Fall	Inner	2.3500	22.259	12	0.4730 n.s.	1.1000	3.6300	3		1.6500	5.4450	2	
	Outer	1.1600	4.8760	10		0	0	4		0	0	4	
OTHER ALGAE													
Spring	Inner	232.12	13298	12	0.3032 n.s.	123.80	333.97	3	0.2298 n.s.	73.800	397.62	2	0.8275 n.s.
	Outer	1380.6	$.14298 \times 10^8$	10		98.650	744.09	4		88.300	6778.6	4	
Summer	Inner	32.467	582.94	12	0.0445 *	27.100	552.76	3	0.6093 n.s.	17.850	330.24	2	0.4722 n.s.
	Outer	13.090	277.54	10		19.875	133.93	4		64.675	6089.3	4	
Fall	Inner	174.67	4479.7	12	0.6327 n.s.	138.13	487.86	3	0.9235 n.s.	199.80	18164.	2	0.1818 n.s.
	Outer	199.32	25785.	10		130.57	15684.	4		89.950	2177.5	4	
TOTAL ALGAE													
Spring	Inner	4668.3	$.14926 \times 10^7$	12	0.4082 n.s.	3165.8	$.97716 \times 10^6$	3	0.5130 n.s.	1966.4	35192.	2	0.7396 n.s.
	Outer	6830.7	$.77586 \times 10^8$	10		2647.1	$.90053 \times 10^6$	4		2081.7	$.17424 \times 10^6$	4	
Summer	Inner	2821.1	$.30834 \times 10^7$	12	0.3717 n.s.	1970.3	$.98099 \times 10^6$	3	0.8593 n.s.	2130.6	$.89740 \times 10^6$	2	0.5826 n.s.
	Outer	3717.4	$.78921 \times 10^7$	10		2080.0	$.33432 \times 10^6$	4		3666.8	$.11470 \times 10^8$	4	
Fall	Inner	6021.0	$.36109 \times 10^7$	12	0.1446 n.s.	5017.3	$.29261 \times 10^7$	3	0.5855 n.s.	4829.9	$.33367 \times 10^7$	2	0.4642 n.s.
	Outer	4773.7	$.37679 \times 10^7$	10		4239.2	$.31471 \times 10^7$	4		3522.5	$.35383 \times 10^7$	4	

TABLE 7. Algal abundances (cells/mL), by algal categories, at inner (treatment) and outer (control) station groups in three depth zones in April 1982. In each season in each depth the mean count of cells/mL at inner stations is compared to that at outer stations using a two-sample t-test. Symbols used: n.s. = no significant difference between the two groups; * = significance at the .05 level; ** = significance at the .01 level; and N = the number of stations for which data were available. No test was made if one of the groups contained only a single observation, or if one of the group variances was zero.

Survey	Station Group	Zone 0 (0-8m) Means	Variance	N	t-test	Zone 1 (8-16m) Means	Variance	N	t-test	Zone 2 (16-24m) Means	Variance	N	t-test
COCCOID BLUE-GREEN ALGAE													
Spring	Inner	257.27	.27777x10^6	12	0.2087 n.s.	0	0	3		3.3000	21.780	2	0.5533 n.s.
	Outer	37.810	6375.8	10		0	0	4		73.375	20897.0	4	
FILAMENTOUS BLUE-GREEN ALGAE													
Spring	Inner	13.523	119.08	12	0.2380 n.s.	11.033	69.853	3	0.4563 n.s.	9.9500	22.445	2	0.6930 n.s.
	Outer	34.810	3563.0	10		70.875	15703.	4		7.4500	54.150	4	
COCCOID GREEN ALGAE													
Spring	Inner	480.98	.16584x10^7	12	0.5996 n.s.	21.000	47.190	3	0.2279 n.s.	39.800	353.78	2	0.3782 n.s.
	Outer	251.20	.22235x10^6	10		129.72	17862.	4		21.150	512.82	4	
FILAMENTOUS GREEN ALGAE													
Spring	Inner	8.0083	182.79	12	0.7322 n.s.	26.533	1630.3	3	0.4418 n.s.	0	0	2	0.3552 n.s.
	Outer	10.270	291.39	10		8.3000	275.56	4		2.4750	9.9825	4	
FLAGELLATES													
Spring	Inner	2185.2	.18220x10^7	12	0.1661 n.s.	1372.9	.10987x10^6	3	0.8801 n.s.	1450.8	.21334x10^6	2	0.6008 n.s.
	Outer	1533.9	.26234x10^6	10		1307.4	.41351x10^6	4		1271.7	.10605x10^6	4	
CENTRIC DIATOMS													
Spring	Inner	1950.7	.64635x10^6	12	0.6042 n.s.	938.47	78146.	3	0.7128 n.s.	727.90	.12873x10^6	2	0.2440 n.s.
	Outer	1809.6	80053.	10		834.40	.15159x10^6	4		458.02	26600.	4	
PENNATE DIATOMS													
Spring	Inner	1590.1	.59103x10^6	12	0.1509 n.s.	961.70	17064.	3	0.9435 n.s.	708.00	.11558x10^6	2	0.9474 n.s.
	Outer	1201.9	96147.	10		940.95	.21044x10^6	4		686.02	.13567x10^6	4	
DESMIDS													
Spring	Inner	0.5500	1.6500	12	0.5684 n.s.	0	0	3		0	0	2	0.5415 n.s.
	Outer	0.9900	4.9610	10		0	0	4		0.8250	2.7225	4	
OTHER ALGAE													
Spring	Inner	360.36	80357.	12	0.5510 n.s.	190.13	7721.4	3	0.5203 n.s.	77.900	137.78	2	0.0495 *
	Outer	301.95	14182.	10		134.72	13220.	4		40.200	279.39	4	
TOTAL ALGAE													
Spring	Inner	6846.7	.12021x10^8	12	0.1601 n.s.	3521.7	.42705x10^6	3	0.9263 n.s.	3017.6	.13094x10^7	2	0.5103 n.s.
	Outer	5182.4	.10831x10^7	10		3426.4	.24589x10^7	4		2561.3	.27412x10^6	4	

Zone 0	Zone 1	Zone 2
Inner greater 1 + 2	Inner greater 3 + 2	Inner greater 5* + 14
Outer greater 1 + 3	Outer greater 7 + 5	Outer greater 4 + 3

*Erroneously reported as 6, previously.

Except for the inner station group of depth zone 2, the distributions of significant differences between preoperational and operational years appear to be within the normal range of variation. The increase in numbers of differences in zone 2 inner stations in operational years may possibly be an effect of plant operation, but of the 591 comparisons in operational years it is a minute (2.36%) effect.

CONCLUSIONS

The phytoplankton community in the Cook Plant vicinity in 1980 and 1981 continued an overall trend toward decreased abundance which began after a high in 1978. Declines in diatom abundances (attributed to reduced nutrient loading to the lake) have outweighed variations in the other categories and affected the totals. Coccoid blue-greens in 1981 continued to be low in abundance in spring and summer but to have abundance peaks in fall (attributed to late summer and fall depletion of silica in the epilimnetic water). Flagellates decreased in 1979 and 1980 but returned to their 1978 level in 1981. The remaining categories of phytoplankton have exhibited little variation in abundances over the twelve years of the study. Abundance changes at both inner and outer stations have generally been in the same directions and are considered to reflect changes in the lake, not any clear effect of Cook Plant operation.

Statistically significant differences between mean abundances of phytoplankton categories at inner and outer stations have been low during the period of study (5.20%) of the comparisons overall, 5.71% in preoperational years, and

4.90% in operational years. Except for the inner station group of depth zone 2, the distributions of significant differences between preoperational and operational years appear to be within the normal range of variation. The increase in numbers of differences in zone 2 inner in operational years may possibly be an effect of plant operation on blue-green algae densities in that area, but of the 591 paired comparisons in operational years it is a minute (2.36%) effect.

Mean diversity indices have varied somewhat from season to season and from year to year during the twelve years of the study. The annual curves of diversity indices indicate, in each depth zone and station group, a gradual trend toward higher indices from 1970 through 1976 followed in subsequent years by a slow trend toward lower levels. In all depth zones and both station groups species diversities indicated by the indices continue to be higher than in the preoperational years. These analyses show no adverse effect of Cook Plant operation.

In 1979 phytoplankton redundancy values rose to preoperational levels after a period of slowly diminishing values from 1973 through 1978; they have remained at preoperational levels in 1980 and 1981. There is nothing in this analysis of phytoplankton redundancies to indicate that operation of Cook Plant has had any adverse impact on the local phytoplankton community.

REFERENCES

Ayers, J. C. 1975. Bacteria and phytoplankton of the seasonal surveys of 1972 and 1973. Benton Harbor Power Plant Limnological Studies. Part XXI. Special Report No. 44, Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 153 pp.

Ayers, J. C. 1978. Phytoplankton of the seasonal surveys of 1976, of September 1970, and pre- vs. post-operational comparisons at Cook Nuclear Plant. Benton Harbor Power Plant Limnological Studies. Part XXV. Special Report No. 44, Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 258 pp.

Ayers, J. C., and L. E. Feldt. 1982. Phytoplankton of the seasonal surveys of 1978 and 1979, and further pre- vs. post-operational comparisons at Cook Nuclear Plant. Benton Harbor Power Plant Limnological Studies. Part XXIX. Special Report No. 44, Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 70 pp.

Ayers, J. C. and S. J. Wiley. 1979. Phytoplankton of the seasonal surveys of 1977, and further pre- vs. post-operational comparisons at Cook Nuclear Plant. Benton Harbor Power Plant Limnological Studies. Part XXVII. Special Report No. 44, Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 92 pp.

Ayers, J. C., W. L. Yocum, H. K. Soo, T. W. Bottrell, S. C. Mozley, and L. C. Garcia. 1971. The biological survey of 10 July 1970. Benton Harbor Power Plant Limnological Studies. Part IX. Special Report No. 44, Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 72 pp.

Ayers, J. C., S. C. Mozley, and J. C. Roth. 1973. The biological survey of 12 November 1970. Benton Harbor Power Plant Limnological Studies. Part XV. Special Report No. 44, Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 69 pp.

Ayers, J. C., S. C. Mozley, and J. A. Stewart. 1974. The seasonal biological surveys of 1971. Benton Harbor Power Plant Limnological Studies. Part XIX. Special Report No. 44, Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 181 pp.

Ayers, J. C., N. V. Southwick, and D. G. Robinson. 1977. Phytoplankton of the seasonal surveys of 1974 and 1975 and initial pre- vs. post-operational comparisons at Cook Nuclear Plant. Benton Harbor Power Plant Limnological Studies. Part XXIII. Special Report No. 44, Great Lakes Research Division, The University of Michigan, Ann Arbor, Michigan. 279 pp.

Drouet, F. 1968. Revision of the classification of the Oscillatoriaceae. Monograph 15, The Academy of Natural Sciences of Philadelphia.

Great Lakes Water Quality Board. 1981. Report to the International Joint Commission: 1981 Report on Great Lakes Water Quality. Cleveland, Ohio. vii and 74 pp.

Michigan Water Resources Commission. 1970. Great Lakes algae monitoring program 1969. State of Michigan, Lansing, Michigan. 16 pp.

Sanford, G. R., A. Sands, and C. R. Goldman. 1969. A settle-freeze method for concentrating phytoplankton in quantitative studies. Limnol. Oceanogr. 14:790-794.

Tarapchak, S. J. and E. F. Stoermer. 1976. Phytoplankton of Lake Michigan. Environmental Status of the Lake Michigan Region. Vol. 4. Argonne National Laboratory, Argonne, Ill. ANL/ES Vol. 4. 204 pp.

Wilhm, J. L. and T. C. Dorris. 1968. Biological parameters for water quality criteria. Bioscience 18 (6):447-481.